REGULATORY IMPACT ANALYSIS

FOR

PROPOSED

OZONE

NATIONAL AMBIENT AIR QUALITY STANDARD

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LIST OF ACRONYMS

ACT	Alternative Control Techniques
AIRS	Aerometric Information Retrieval System
AIRCOST	utility SO_2 control cost model (E.H.Pechan & Associates)
AF	air/fuel adjustment
AP-42	compilation of air pollutant emissions factors
BARCT	best available retrofit control technology
BEA	Bureau of Economic Analysis
BOOS	burners out-of-service
CAA	Clean Air Act
CAAAC	Clean Air Act Advisory Committee
CASAC	Clean Air Scientific Advisory Committee
CRDM	Climatological Regional Dispersion Model
CARB	California Air Resources Board
CO	carbon monoxide
CS-C	control strategy-cost
CTG	control technique guidelines
DOE	Department of Energy
EPA	Environmental Protection Agency
EIA	Energy Information Administration
ERCAM	Emission Reductions and Cost Analysis Models
ERCAM NO_x	Enhancements to the Emission Reduction and Cost Analysis Models for No_x
ERCAM VOC	Enhancements to the Emission Reduction and Cost Analysis Models for VOC
ESP	electrostatic precipitator
FAC	aerosol coefficients
FACA	Federal Advisory Committee Act
FGD	flue gas desulfurization
FGR	flue gas recirculation
FIP	Federal implementation plan
FMVCP	Federal Motor Vehicle Control Program
GCVTC	Grand Canyon Visibility Transport Commission
GDP	gross domestic product
GSP	Gross State Product
ICI	industrial, commercial, and institutional
ISCST	Industrial Source Complex Short Term
I/M	inspection/maintenance
IR	ignition timing retardation
LAER	lowest achievable emission rate
LEA	low excess air
LEV	low emission vehicle

LNB	low-NO_x burner
MACT	maximum achievable control technology
MSA	metropolitan statistical area
NAAQS	national ambient air quality standards
NAMS	National Air Monitoring Stations
NAPAP	National Acid Precipitation Assessent Program
NEI	National Emissions Inventory
NH_3	ammonia
NSR	New Source Review
NGR	natural gas recirculation
NO_X	oxides of nitrogen
NPI	National Particulate Inventory
NSCR	non-selective catalytic reduction
NSPS	New Source Performance Standard
OMB	Office of Management and Budget
OMTG	open market trading guidelines
O&M	operating and maintenance
OAQPS	Office of Air Quality Planning and Standards
OFA	overfire air
OMS	Office of Mobile Sources
OXYFIRING	firing of glass furnaces with oxygen-enriched combustion air
PAMS	Photochemical Assessment Monitoring Stations
PM	Particulate Matter
P-V valves	pressure-vacuum valves
RACT	reasonably available control technology
RADM	RegionalAcid Deposition Model
RFA	Regulatory Flexibility Analysis
RIA	Regulatory Impact Analysis
RIS	Regulatory Impact Statement
ROM	Regional Oxidant Modeling
RVP	Reid Vapor Pressure
S-R	source-receptor
SBREFA	Small Business Regulatory Enforcement Fairness Act
SCAQMD	South Coast Air Quality Management District
SCR	selective catalytic reduction
SIC	Standard Industrial Classification
SIP	State implementation plan
SLAMS	State and Local Air Monitoring Stations
SNCR	selective non-catalytic reduction
SOA	secondary organic aerosols
SOCMI	Synthetic Organic Chemical Manufacturing Industry

SO_2	sulfur dioxide
SBA	Small Business Administration
SPMS	special purpose monitors
TAC	total annual costs
TCI	total capital investment
TSP	total suspended particulate
ULNB	ultra low-NO_x burner
UMRA	Unfunded Mandates Reform Act
USDA	U.S. Department of Agriculture
VOC	volatile organic compound
VMT	vehicle miles traveled

EXECUTIVE SUMMARY FOR OZONE REGULATORY IMPACT ANALYSIS

The Clean Air Act directs the Environmental Protection Agency (EPA) to identify and set national standards for pollutants which cause adverse effects to public health and the environment. EPA is also required to review the health and welfare-based standards at least once every five years to determine whether, based on new research, revisions to the standards are necessary to continue to protect public health and the environment. Recent scientific evidence indicates that ground-level ozone not only affects people with impaired respiratory systems (such as asthmatics), but healthy adults and children as well. The new studies taken into account during this latest review show health effects at levels below that of the current standard (0.12 ppm, 1-hour form). In particular, exposure of active children and outdoor workers engaged in moderate exercise for 6-8 hours may experience several acute effects such as decreased lung function and acute lung inflammation (which could lead to premature aging of the lung) down to 0.08 ppm. Recent studies also provide evidence of an association between elevated ozone levels and increases in hospital admissions; and animal studies indicate repeated exposure to high levels of ozone for several months can produce permanent structural damage in the lungs. As a result of the most recent review process, EPA is proposing to revise the primary (health-based) and secondary (welfare-based) National Ambient Air Quality Standards (NAAQS) for ozone. Pursuant to Executive Order 12866, this draft Regulatory Impact Analysis (RIA) assesses the costs, economic impacts, and benefits associated with the *implementation* of these and alternative NAAQS for ozone.

In setting the primary air quality standards, EPA's first responsibility under the law is to select standards that protect public health. In the words of the Clean Air Act, for each criteria pollutant EPA is required to set a standard that protects public health with "an adequate margin of safety." As interpreted by the Agency and the courts, this decision is a *health-based* decision that specifically is *not* to be based on cost or other economic considerations. This reliance on science and prohibition against the consideration of cost does not mean that cost or other economic considerations are not important or can be ignored. In fact, the Agency believes that consideration of cost is an essential decision making tool. However, under the health-based approach required by the Clean Air Act, the appropriate place for cost and efficiency considerations is during the development of implementation strategies, strategies that will allow communities, to meet the health-based standards. Through the development of national emissions standards for cars, trucks, fuels, large industrial sources and power plants, for example, and through the development of appropriately tailored state and local implementation plans, the implementation process is where decisions are made -- both nationally and within each community -- affecting how much progress can be made, and what time lines, strategies and polices make the most sense.

In summary, this draft RIA and associated analyses are intended to generally inform the public about the potential costs and benefits that may result when the proposed revisions to the ozone NAAQS are implemented by the States, but are not relevant to establishing the standards themselves.

General Limitations of this Analysis

The consideration of cost and, to be more specific, the use of cost-benefit analyses, provides a structured means of evaluating and comparing various implementation policies, as well as a means of comparing the variety of tools and technologies available for air pollution control efforts. The Agency has found the use of such analyses to be of significant value in developing regulatory options over the years.

General limitations, however, continue to affect the accuracy of cost-benefit analyses. For example, wide ranges of uncertainties often exist within an analysis, especially within studies of national scope involving forecasts over extended periods of time. Analyses, and therefore results, continue to be limited by the inability to monetize certain health or welfare benefits - such as protection against loss of lung function, or ecosystem damage. Comparisons of such incomplete benefits to the more quantifiable and usually more complete control costs can be misleading. In addition, though pollution control costs are generally more quantifiable, those costs may be overstated for many reasons: regulated entities concerned about such costs often overstate their cost projections to support their position; a belief by some analysts that conservative planning requires over-estimation; or an inability to forecast significant improvements in the cost-effectiveness of pollution control that generally occur over analytical periods of five to ten years.

Cost-benefit analyses also often notably fail to deal with distributional issues, (i.e. to provide for the consideration of equity among those who would receive benefits and those on whom the costs would fall). For example, while the direct costs of proposed controls may fall on large industrial sources, costs are often passed on to a large customer base, or to a broader community base. Therefore, while the costs per family may be small, the benefits to those who avoid respiratory problems or death may be large. Further analysis is necessary to fully understand these effects.

These limitations notwithstanding, the process of developing such analyses can still provide useful insights for those working to develop implementation strategies because the analytical framework provides an evaluation, however roughly, of strategies or tools against a common yardstick. For example, this economic analysis provides estimates concerning possible cost impacts for certain industrial categories. Tailored regional strategies would likely serve to mitigate negative impacts on local industries. Finally, these analyses can help to identify existing data gaps, additional information needs, and tools and limitations inherent in certain strategies.

Within these kinds of practical problems lie the general difficulty associated with cost- benefit analyses. By their nature cost-benefit studies must be full of caveats and warnings about the value of their conclusions. Even the most narrowly focused and rigorous should therefore clearly not be the sole determinative test, but should instead serve as useful analytical tools. Unfortunately, the tendency is for such analyses to be referred to in more definitive terms, and for the conclusions, as uncertain as they may be, to taken out of context. Such conclusions should clearly not be the case here.

Specific Limitations of this Analysis

EPA is proposing decisions on the PM and ozone NAAQSs simultaneously. Because these NAAQSs are separate regulatory decisions, separate RIAs were prepared. However, significant overlap may exist in both the benefits and costs associated with reducing ozone and PM concentrations. Some community health studies find associations between both pollutants and health effects such as lung function changes, increased hospital admissions and increased mortality. This overlap is due to important commonalities between ozone and PM (primarily PM2.5) such as 1) similar atmospheric residence times leading to long-range transport; 2) similar combustion-related source categories that emit gaseous precursors that lead to ozone and PM formation; and 3) similar atmospheric chemistry driven by the same chemical reactions and intermediate chemical species which often favor both high ozone and fine particle levels (see 61 F.R. 29719, June 12, 1996 - Advance Notice of Proposed Rulemaking). This RIA employed existing non-integrated technical models and implementation strategies that were not able to adequately account for these commonalities.

As a consequence of having prepared separate RIAs for the PM and Ozone NAAQSs, the sum of the estimated impacts presented in these analyses is likely to overstate the control cost impacts resulting from joint attainment of both proposed standards. Controls designed to reduce one pollutant frequently also achieve reductions of the other. Such co-control can be direct or indirect via air chemistry interactions. Thus, for example, if control measures designed to reduce PM also achieve significant ozone reductions, the benefits of attaining the proposed PM standard presented in this analysis may be understated. Similarly, if control measures designed to reduce ozone also achieve significant PM reductions, the benefits of attaining the proposed ozone standard may be understated.

Another major limitation which affects the results of this RIA is the assumption of the current implementation approach from which to measure the cost of attaining the new standards. The strategies used are limited in part because of our inability to predict the breadth and depth of the creative approaches to implementing these new NAAQS, and in part by technical limitations in modeling capabilities. These limitations, in effect, force costs to be developed based on compliance strategies that may reflect suboptimal approaches to implementation, and therefore, those that likely reflect higher potential costs for attaining the new standard. This approach renders the result specifically useful as an incentive to pursue lower cost options, but is limited as a helpful indicator of likely costs. EPA has not estimated the increases in effectiveness or reductions in cost that might result from new implementation strategies.

It is important to recognize here that if new ozone or particulate matter standards are finalized under the Clean Air Act, the Act allows for substantial new flexibility in the development of implementation strategies, both for control strategies as well as schedules. To the extent that it is warranted, the Act allows for an extension of attainment deadlines as well. This new flexibility may also mean the development of different patterns of designations, and moving away from the traditional attainment-nonattainment delineations. Thus, cost estimates presented in this RIA may overstate actual costs and the net benefit estimates presented understate actual net benefits. However, the CAA would require that States eventually achieve the standards.

Even under the current standards, the Agency has begun to put an emphasis on strategies that can use the marketplace to reduce costs, utilize national strategies where they make sense, and that can look to regional and other cooperative approaches -- so that we maximize efficiencies and minimize costs throughout the pollution control system. EPA and a large number of States are already working in this direction through the Ozone Transport Assessment Group, through the Ozone Transport Commission in the Northeast and through our own efforts to encourage market approaches for ozone precursors. We also are working with Western States through the Grand Canyon Visibility Transport Commission, which is addressing the visibility impacts of both ozone and particles.

Specific to the new ozone and PM standards, EPA also has established a formal advisory committee under the Federal Advisory Committee Act. The specific purpose of the broad-based stakeholder group is to advise EPA on ways to develop innovative, flexible, practical and cost-effective implementation strategies, and to advise us directly on transitional strategies as well.

Among the innovative strategies that FACA may consider are the "Cool Cities," "Green Lights," and "Climate Wise" programs, as well as development of clean fuel fleets and economic incentive programs (such as California's RECLAIM and EPA's Acid Rain program) to harness market forces to reduce pollution in the most cost-effective manner possible. FACA also may consider an integrated control strategy that analyzes control measures jointly (e.g., reformulated gasoline, low-emission vehicles, and selective catalytic reduction). This integrated control analysis is expected to result in lower estimated costs. At the present moment, however, the potential extent of the impact on ambient ozone concentrations (or the cost of attaining alternative standards) resulting from programs such as these is not clear.

This group has specifically been tasked with consideration of strategies that would allow the future integration of ozone, PM, and regional haze control programs. This approach is intended to develop control strategies that recognize the significant overlap and similarities that exist among these pollutants as mentioned above.

Similarities between ozone and PM clearly provide management opportunities for optimizing and coordinating monitoring networks, emission inventories and air quality models, and for creating opportunities for coordinating and minimizing the regulatory burden for sources that would otherwise be required to comply with separate controls for each of these pollutants.

Significant shortcomings also exist as to the data available for these analyses. Existing emissions inventories and modeling to date, either on a national scale, or on an aggregated basis, simply do not provide a sufficient analytical basis from which to draw accurate results. Projections concerning which areas will be classified as nonattainment can only be developed through extrapolation from existing ozone data -- an imprecise exercise at best -- and through the use of very uncertain modeling exercises. For example, at the time this analysis was begun, the best available inventory of VOC and NOx emissions was based on the Interim 1990 inventory, which requires reporting of only sources greater than one hundred tons per year of VOC or NOx. Many sources, while contributing to the overall ozone problem, may not have been part of this analysis' inventory. Shortcomings exist for modeling as well. The Regional Oxidant Model (ROM) was the best ozone modeling tool available for this RIA. However, the ROM model applies to a rectangular grid which includes all or part of the thirty seven states in the East. Predicting ozone concentrations in the West based upon modeled results in the East reduces the reliability of this RIA's results. The combination of these uncertainties must inevitably provide uncertain results.

And finally, the nature of these kinds of analyses is that of a snapshot in time. The cost of implementing these standard revisions in the first few years will mainly be related to planning, control strategy development and creating state implementation plans. Therefore, we selected a year more reflective of the implementation of a new standard. The year 2007 was chosen because most of the mandatory CAAA requirements will have fully taken effect and most areas currently in violation are required to achieve attainment with the current NAAQS standard by this year. Therefore, results are based on air quality modeling performed for this single "representative" year. Multi-year air quality modeling was not feasible because of resource constraints. The limitations imposed by this snapshot approach are particularly troublesome in this case, primarily because of two reasons.

First, in terms of developing strategies or technologies, a decade can see many changes. For example, relative to air pollution control policy, since 1987 we have seen large scale revisions of the Clean Air Act - including complete rewrites of nonattainment, acid rain and air toxics policies - the Intermodal Surface Transportation and Efficiency Act, and the Energy Policy Act. Recently, we have also seen the introduction of utility deregulation at the state and national level. All of these actions, both together and individually, are having important and, in some cases, dramatic effects on air pollution control policy.

In terms of technology, in the last decade we have seen the introduction of three generations of cleaner gasoline (i.e. low RVP, oxygenated and reformulated fuels), cleaner diesel fuels, the introduction of cleaner vehicles (such as electric vehicles), dramatic improvements in scrubber technology for sulfur dioxide controls, the development of replacements for phased-out CFC's, far more cost-effective ways to control auto tail-pipe emissions and the development of on-board diagnostic equipment to assure those cleaner standards continue to be met over time.

Second, relative to attainment of national ambient air quality standards, since 1990 alone we have seen more than half of the areas in violation of the standards for ozone and carbon monoxide begin to meet the standards, many actually ahead of schedule. Moreover, the costs associated with many of these efforts are less than was estimated, even as late as 1990.

Therefore, in the case of air pollution control, ten years is a very long time over which to carry assumptions. Furthermore, a 2007 snapshot does not allow sufficient time for all areas to reach attainment, even under the current standard. Given the likelihood that new standards will result in additional time for some areas, it is clear that some areas will not be required to be in attainment by 2007. This analysis recognizes this by not arbitrarily forcing all areas to reach attainment of the new standards in 2007 by the use of extreme control measures recognizing that such extreme measures are unlikely ever to be put in place.

Also, specific to the limitations of this analysis, the additional costs and health benefits of a separate secondary standard have not been estimated. However, a number of inferences can be made from the results of the welfare benefits analysis under the full attainment scenarios. For the proposed standard, monetized benefits from commodity crops of the most stringent secondary standard incremental to the primary standard are close to zero. This indicates that the proposed primary standard is binding for those areas where commodity crops are grown (which includes California). For these areas, there would be no incremental improvements and, therefore, no additional costs or health benefits. For areas where we do not know if the proposed primary standard is binding (areas where commodity crops are not grown), the air quality database created to perform the commodity crops analysis will be used to estimate any additional health benefits. These benefits are expected to be small because the benefits curves flatten as the air quality improves marginally. At this time, it is not possible to estimate these costs of emission reductions necessary to attain the secondary standard because of incomplete emission inventory data in these areas. However, the Agency will attempt to address these costs in the RIA for the promulgation of this proposed NAAQS.

The reader should keep all of the above limitations in mind when reviewing and interpreting the results presented below.

Nature and Sources of Ozone

Ozone is created when its two primary components, volatile organic compounds (VOCs) and oxides of nitrogen (NOx), combine in the presence of sunlight under specific meteorological conditions. Because ozone cannot be formed without VOC and NOx, these two classes of compounds are often referred to as *precursors*, which are, for the most part, emitted directly into the atmosphere from a combination of natural and anthropogenic sources. Attempts to decrease ozone pollution in the United States has been confounded by a number of factors, including the inherent non-linearity of the photochemical smog mechanism, the contribution of natural precursor emissions, long range transport of ozone and its precursors (primarily NOx), meteorological variability, the general lack of essential data (primarily inventory related), and the limitations of current modeling tools. Based on the review of the scientific criteria and the recommendations of the external advisors, the EPA is proposing to revise the ozone standard.

Overview of RIA Methodology: Inputs and Assumptions

Due to the long lead time needed to complete certain analyses, this RIA does not directly analyze the implementation of the proposed ozone primary (an eight hour concentration based third highest daily maximum .08 ppm form) or secondary standards. Instead, the analyses presented here provide upper and lower bounds to the expected costs, benefits, and economic impacts associated with the proposed standard given the implementation of current command-and-control strategies and other limitations discussed throughout. Two alternative eight hour forms examined (an eight hour concentration based fifth highest daily maximum .08 ppm form, referred to in the RIA as the 8H5EX-80 form; and an eight hour concentration based second highest average daily maximum .08 ppm form, referred to as the 8H1AX-80 form) are used to bound the estimates of the likely costs of the proposed standard. We also estimated the costs and benefits of other alternative options presented in the ozone Staff Paper. Figure ES-1 summarizes the analytical steps used to estimate these benefits and costs of the alternatives analyzed.

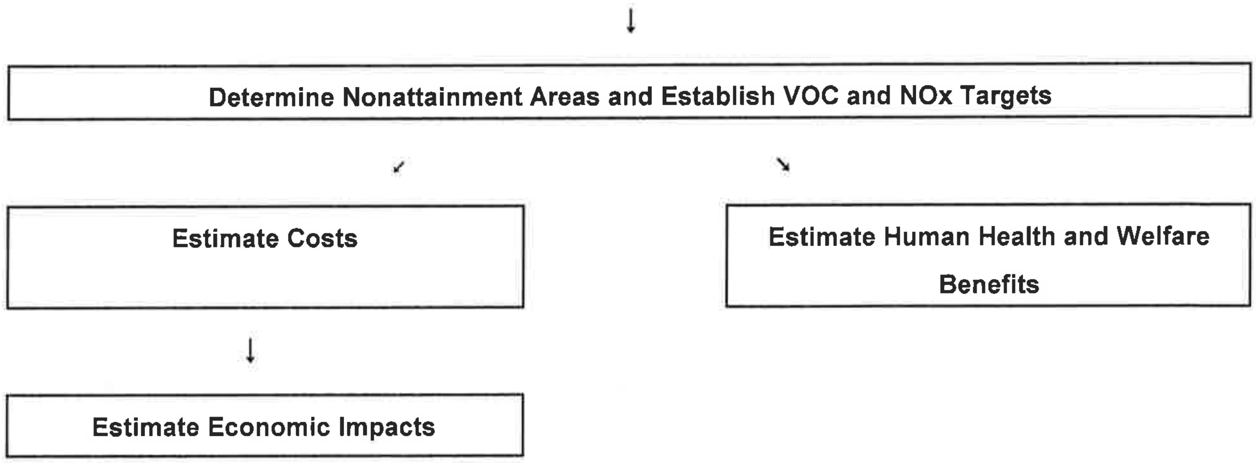
FIGURE ES-1

Flowchart of Analytical Steps

Estimate 2007 Emissions

↓

Estimate Ambient Ozone Air Quality



As noted earlier, the year 2007 was chosen to provide an appropriate baseline for a period in which the new standards are being implemented. These analyses have been constructed such that benefits are estimated incremental to those derived from the combined effects of implementing both the Clean Air Act Amendments and the current ozone NAAQS as of the year 2007. These analyses provide a "snapshot" of potential benefits and costs of the proposed ozone NAAQS in the context of (1) implementation of CAA requirements between now and 2007, (2) the effects on air quality that derive from economic and population growth, and (3) the beneficial effects on air quality that the Agency expects will result from a series of current efforts to provide regional level strategies to manage the long range transport of NOx. In particular, this RIA approximates the combined beneficial effects from a number of separate regional efforts by applying a NOx control strategy similar to the Ozone Transport Region (OTR) Memorandum of Understanding (MOU), which requires a 0.15 pounds per million BTU cap on utility and fossil fuel boilers and a 49-State light Emission Vehicle (LEV) program in all of its member States. Programs such as these would, upon implementation, reduce the effect of long-range transport.

Analyses were conducted for all counties in the contiguous United States. To predict baseline air quality in the year 2007, emission inventories were developed for 1990 and then projected to 2007 based upon estimated national population growth and industrial development. Clean Air Act-mandated controls (e.g., Title I VOC and NO_x Reasonably Available Control Technology, Title II mobile source inspection/maintenance programs, Title III air toxics controls and Title IV Acid Rain NO_x controls) were applied to these inventories to estimate emission reductions through 2007 as a result of CAA requirements. Predicted 2007 CAA emissions were entered into an air quality model that relates emission sources to county-level ozone concentrations. Modeled air quality was used to identify counties predicted to not attain the alternative ozone standard levels[1]. We identified nonattainment areas by identifying each county that was expected to exceed the NAAQS (in accordance with current Agency procedures for identifying nonattainment areas). The potential costs and economic impacts on affected industry sectors was then analyzed. County level ozone concentrations fed directly into the benefits analyses performed in this RIA. Potential health and welfare benefits are estimated from predicted changes in ozone air quality in monitored as well as unmonitored counties as a result of control strategies applied in the cost analysis. Finally, benefits and costs were compared to examine questions of economic efficiency.

We applied what we considered a reasonable set of control measures for controlling ozone under the Clean Air Act. For some counties, the analysis finds that the control measures identified in the cost analysis would not be sufficient to result in attainment of the alternatives by 2007. This incomplete attainment situation is believed to be in part a byproduct of the analysis itself. However, there are likely to be be cases in which currently identifiable controls are not enough to reach attainment of the revised standard by 2007, which is the attainment date for certain nonattainment areas under the current standard. Control strategies necessary to achieve attainment of the proposed ozone standard in all areas may be identified in the future. It is also reasonable to assume that only some areas will be required to attain the standard in the year 2007. It is possible that some areas will be given additional time to reach attainment, so that attainment of the standard occurs after 2007. EPA has convened a

1 For the purposes of this RIA, the term attain or attainment is used to indicate that ozone air quality level specified by the standard alternative is achieved. Because the analyses in this RIA are based on one-year of air quality data, they are only estimates of actual attainment because the standard alternatives are specified as 3-year averages.

large group of stakeholders to develop new PM and ozone NAAQS implementation strategies that may offer States innovative and more effective approaches to attainment of the ozone NAAQS.

This analysis focuses on the costs, economic impacts, and benefits associated with partial attainment of alternative ozone standards. All comparisons of benefits and costs are made on a partial attainment basis. While plausible estimates of full-attainment benefits also are presented, no credible approach for estimating full-attainment costs could be developed. Nevertheless, an average cost per ton range of values is presented in conjunction with the emission reductions necessary to achieve full attainment. This information is presented in the cost chapter for the purposes of completeness.

Cost and Economic Impact Analyses

Annual control costs (in 1990 dollars) to attain each alternative NAAQS were estimated for controls installed in 2007 at sources within the identified nonattainment areas. In each area, control measures came exclusively from within the nonattainment area (within the baseline, however, regional strategies were applied to all counties, regardless of attainment status because the ozone problem is driven largely by regional transport for the Eastern U.S.). This RIA assumes that marginal nonattainment areas will not incur control costs, only administrative costs. However, it is possible that additional control measures may be needed to achieve some air quality improvements in some marginal nonattainment areas. The costs associated with achieving the improvements are likely to be small relative to other costs presented in this RIA. To the extent that there are control costs associated with these marginal nonattainment areas, the costs presented in this analysis are understated but are not expected to significantly affect the national estimates due to the small magnitude of the costs in question. The administrative costs of implementing the ozone NAAQS has not been estimated in this analysis. However, administrative costs will be assessed for the part 51 Ozone NAAQS analysis, in fulfillment of Paperwork Reduction Act requirements.

Annual costs were estimated by applying control measures for the purpose of meeting emission "targets" identified for each nonattainment area to meet each alternative NAAQS. It is expected that as the NAAQS is made more stringent (e.g., moving from the current standard to an 8-hour, 5 exceedance standard), the VOC or NOx emission targets decrease. In general, the estimated targets for each nonattainment area under each of the alternative NAAQS conforms to this expectation. However, upon review of the data used in this analysis, there are several important metropolitan areas where the target estimates do not decrease as the stringency of the alternative standards increase. To the extent that the emission targets are overestimated, the control costs presented for the affected alternatives are also underestimated (although the presence of residual nonattainment may result in zero marginal control costs regardless of the level of the targets). The emission targets will be more closely examined for the RIA for promulgation of the proposed NAAQS.

Economic impacts based on these control costs were estimated for the same ozone NAAQS alternatives. These impacts include a screening analysis providing estimated annual average cost-to-sales ratios for all affected industries and small entities.

Key Results and Conclusions

- Annual identifiable control costs corresponding to the partial attainment of the two ozone alternatives which bound the proposed standard range from approximately $0.6 to $2.5 billion per year incremental to the current standard.

- The total number of residual nonattainment areas corresponding to the two ozone alternatives which bound the proposed standard range between 12 and 24 areas.

- The implication of residual nonattainment is that areas with a VOC or NOx deficit need more time; new control strategies (e.g., regional controls or economic incentive programs); and/or new technologies in order to attain the standard.

- Under the control scenario selected, at least one or more establishments (e.g. industrial plant) in up to 25 to 30 percent of U.S. industries (as defined by 3-digit SIC codes) may be affected by the chosen alternative as estimated in a screening analysis that calculated cost-to-sales ratios for each affected industry. Approximately 1/4 of these are estimated to have cost-to-sales ratios exceeding 3 percent, and therefore may experience potentially significant impacts. At least one or more small establishments in up to 18 percent of affected U.S. industries are estimated to have cost-to-sales ratios exceeding 3 percent, and therefore these small establishments may experience potentially significant impacts. These results are highly sensitive to the choice of control scenario. Because of the previously discussed limitations of the implementation strategy used for the analysis, the results are only useful as guidance for the FACA committee in designing new approaches to controlling both ozone and PM.

Benefit Analysis

Health and welfare benefits were estimated for attainment of alternative ozone standards. While ozone and its precursors can be transported large distances, the health benefits of air quality improvements outside of nonattainment areas (based on controls within those areas) was not assessed which will lead to an understatement of actual benefits. The change in incidence of health and welfare effects was estimated for each air quality change scenario as defined by the 2007 baseline and post-attainment air quality distributions. These changes in incidence were then monetized by multiplying the estimated change in incidence of each endpoint by its associated dollar value of avoiding an occurrence of an adverse effect. These endpoint-specific benefits were then summed across all counties to derive an estimate of total benefit. Because there are categories for which benefits are not quantified or monetized given lack of scientific and economic data, the benefit estimates presented in this analysis are incomplete.

The benefits in this analysis are estimated only for effects directly related to ozone exposure. Reduction of ozone also results in reduced effects of ozone precursors (VOC and NO_x) and of other toxic substances produced in the photochemical processes that form ozone (formaldehyde, fine particles). The benefits of the indirect effects, which may be substantial, have not been quantified. Table ES-1 lists the health and welfare benefit categories that are reasonably associated with reducing ozone in the atmosphere, specifying those for which sufficient quantitative information exists to permit benefit calculations.

Monetized benefits for full attainment of each of the ozone alternatives have been estimated. Implicit within this analysis is the assumption that all counties reach attainment of each of the standard alternatives. However, the control strategy-cost analysis indicates that some counties do not reach attainment of the alternative standards given that the control measures identified in the cost analysis do not sufficiently reduce emissions to achieve attainment in 2007. Estimates of full attainment benefits are presented to allow an understanding of the scope of

TABLE ES-1: Benefit Categories

Unquantified Benefit Categories	Quantified Benefit Categories (in numbers of incidences and/or dollars)
Health Benefit Categories (from a reduction in ozone and related pollutants)	
Airway responsiveness Increased susceptibility to respiratory infection Acute inflammation and respiratory cell damage Premature aging of lungs/chronic respiratory damage Reduced cancer and adverse attacks from toxic ozone precursors and associated oxidant products Reduced mortality/morbidity from lower fine particle levels	Coughs Pain upon deep inhalation Mortality Hospital admissions for all respiratory illnesses Hospital admissions for pneumonia Hospital admissions for chronic obstructive pulmonary disease (COPD) Presence of any of 19 acute respiratory symptoms/ restricted activity days Self-reported asthma attacks Worker productivity Change in lung function Lower respiratory symptoms
Welfare Benefit Categories	
Ecosystem and vegetation effects in Class I areas (e.g. National Parks) Damage to urban ornamentals (e.g., grass, flowers, shrubs, trees) Reduced yield of tree seedlings and non-commercial forests Damage to ecosystems Materials damage Nitrogen deposition in sensitive nitrogen-saturated coastal estuaries and ecosystems Visibility	Increased yields for: Commodity crops Fruits and vegetables Commercial forests

benefits that would be attributable to alternative standards provided that control strategies to reach complete attainment can be identified and adopted. Benefit results for partial attainment are also presented to assure that benefits and costs can be appropriately compared. Estimates of benefits for hypothetical full attainment in 2007 are also presented to allow an understanding of the scope of benefits that would be attributable to alternative standards in the event that control strategies to reach complete attainment are identified and implemented by that date.

Key Results and Conclusions

- Estimated total monetized benefits associated with implementation of the proposed ozone standard incremental to the current ozone NAAQS are substantial based on the alternatives which bracket the proposal.

- Full attainment of the lower bound ozone alternative results in estimated benefits of between $0.1 and $1.4 billion per year. Annual benefits range between an estimated $0.2 and $2.8 billion for the upper bound alternative under full attainment. Mortality benefits represent about 90% of the upper bound benefits estimate.

- Partial attainment of the lower bound ozone alternative results in estimated annual benefits between $0.1 to $0.6 billion. Partial attainment of the upper bound ozone alternative have an expected benefit of between $0.1 billion and 1.5 billion per year.

- The major benefit categories that contribute to the quantified benefits include mortality, hospital admissions, acute respiratory symptoms and welfare effects. In particular, mortality accounts for the high end of the benefits range estimate. However, this analysis excludes a number of other benefit categories.

Benefit-Cost Comparison

Comparing benefits and costs provides one framework for evaluating alternative standards. The economically efficient alternative maximizes net social benefits (i.e., social benefits minus social costs). Both the Agency and the courts have defined the NAAQS standard setting decisions, both the initial standard setting and each subsequent review, as *health-based* decisions that specifically are *not* to be based on cost or other economic considerations. Instead, this draft benefit-cost comparison is intended to generally inform the public about the potential costs and benefits that may result when the proposed revisions to the Ozone NAAQS are implemented by the States.

Key Conclusions and Limitations

- Within the uncertainties of these analyses and their underlying assumptions, costs and benefits of the partial attainment scenario seem to be of similar magnitude for the partial attainment of the alternatives which bound the proposed approach.

- Firm conclusions about the actual net benefits resulting from the proposed standard should not be drawn from this analysis because of the uncertainties and incompleteness discussed throughout this executive summary.

- A number of these non-monetized benefit categories may be significant. If they could be monetized and added to this analysis, the estimate of the net benefits associated with the proposed alternative could be positive.

- The scope of this analysis did not allow consideration of flexibility in ozone management. The Agency expects the implementation portion of this ozone NAAQS review to result in more flexible control strategies and lower costs. This a second major reason why the cost estimates presented may overstate actual costs and the net benefit estimates presented may understate actual net benefits.

- Due to the existence of residual non-attainment, the partial attainment cost estimates presented understate the actual full cost of attaining the alternative standards. Thus, the net benefits associated with full attainment cannot be estimated with any degree of confidence.

- There are benefits from ozone control that could not be monetized in the benefit analysis, which in turn affect the benefit-cost comparison. Unmonetized benefit categories include: effects in lung function; unquantified chronic respiratory damage and premature aging of the lungs, sinusitis and hay fever; increased susceptibility to respiratory infection; and protection of Class I areas, forests, ornamental plants, mature trees and seedlings, and ecosystems. Health effects from exposure to toxic air pollutants and reduced mortality and morbidity from fine particles are also not included. The effect of our inability to monetize these benefit categories leads to an underestimation of the monetized benefits presented in this RIA.

- Health benefits calculated in this analysis were estimated only within each identified nonattainment area. However, the reduction of ozone precursor emissions in nonattainment areas is expected to reduce ambient ozone concentrations outside of the nonattainment areas due to the transport of air pollution. The effect of not estimating health benefits outside of the identified nonattainment areas leads to an underestimation of the monetized benefits presented in this analysis, to the extent that controls in nonattainment areas or regional or national controls improve air quality in attainment areas.

- The uncertainty associated with the benefit estimates may be significantly greater than the uncertainty associated with the costs estimates. In particular, the benefit estimates vary greatly depending on the mortality risk reduction measure. This issue leads to caution in interpreting this ozone benefit-cost comparison.

- There are uncertainties in the adjustment of the benefit calculations to account for residual nonattainment (labeled as partial attainment).

- Comparisons across alternative standards should be made with caution because control strategies identified do not result in full attainment of the alternatives. As the stringency of the standard increases, areas showing residual nonattainment will have a more difficult time to meet a more stringent standard and the cost of this increasing difficulty is not included in these estimates.

- This analysis only considers the control measure costs. The administrative costs to the States of activities such as changing their State Implementation Plans are not included in this analysis. These costs will be included in the analysis. These costs will be included in the analysis for the implementation phase of these standards.

- Under the current implementation strategy, marginal nonattainment areas generally undertake non-control pollution management efforts (e.g., develop an emissions inventory and keep it updated). This analysis assumes that these efforts indirectly produce air quality improvements. To the extent that there are control costs associated with marginal nonattainment areas, this analysis may underestimate the costs which these areas will actually incur.

- Due to uncertainties associated with the air quality model (which results in an overestimation of the emission reduction targets), an assumption was made that if an area could achieve at least 75% of its emission reduction target, it was assumed to potentially be able to attain the alternative standard. (See the cost chapter for a more complete discussion of this assumption.)

- The costs presented in this analysis represent the control costs of a partial attainment scenario, given the existence of residual nonattainment. Due to significant uncertainties, this analysis does not estimate full-attainment costs. However, the cost chapter provides information on average cost per ton values in conjunction with emission reduction information for the reader's consideration.

- The cost and benefit estimates presented in the results do not account for market reactions to the new alternatives. The cost and benefit estimates represent the direct costs and benefits but not the true social costs (calculated after market adjustments to price and output changes, etc.) associated with implementation of the alternatives examined. Social costs are typically somewhat smaller than direct costs, while social benefits may be greater or less than direct benefits depending on the specific market adjustments and substitutions that occur. Because the effect of market reactions was not assessed, indirect costs and benefits to consumers and producers could not be quantified. It is anticipated that some of the costs associated with control measures will be borne indirectly by consumers instead of producers.

Table ES-2
Comparison of Benefits and Costs
Regional Control Strategy Baseline[1]
(Billions of 1990$)
(Estimates are incremental from the current standard)

Alternative Ozone NAAQS	Annual Monetized Benefits: Full Attainment (a)	Annual Monetized Benefits: Partial Attainment (b)	Annual Costs of Partial Attainment (c)	Annual Net Benefits of Partial Attainment (b - c)[2]	Number of RNA Areas[3]	Deficit Tons in RNA Areas (thousands)	Population in RNA Areas
Current Standard[4]	$0.2 - $2.7	$0.1 - $0.8	$1.2	$(1.1) - $(0.4)	4	370-562 VOC 0 NOx	39 million
Incremental from the Current Standard:							
.08 ppm, 8 hour, 4 AX	$0.1 - $1.4	$0 - $0.6	$0.6	$(0.4) - $0	8 areas	102-155 VOC 17-25 NOX	14 million
.08 ppm, 8 hour, 1 AX	$0.2 - $2.8	$0.1 - $1.5	$2.5	$(2.4) - $(1.0)	20 areas	422-642 VOC 73-111 NOX	32 million

1 Includes NOx cap and 49-state LEV.
2 Numbers in ( ) denote negative values.
3 See the Cost Chapter for a more detailed treatment of residual nonattainment.
4 The current standard is assumed to be approximately equal to an 8-hour, .09 ppm, 2AX alternative.

Table ES-3
Comparison of Benefits and Costs
Local Control Strategy[1] Baseline
(Billions of 1990$)
(Estimates are incremental from the current standard)

Alternative Ozone NAAQS	Annual Monetized Benefits: Full Attainment (a)	Annual Monetized Benefits: Partial Attainment (b)	Annual Costs of Partial Attainment (c)	Annual Net Benefits of Partial Attainment (b - c)	Number of RNA Areas[2]	Deficit Tons in RNA Areas (thousands)	Population in RNA Areas
Current Standard	$0.2 - $3.3	$0.1 - $1.1	$2.3	$(2.2) - $(1.2)	6	506-770 VOC 8-13 NOx	57 million
Incremental from the Current Standard:							
.08 ppm, 8 hour, 4 AX	$0.1 - $2.0	$0 - $1.1	$2.2	$(2.4) - $(1.1)	12 areas	188-285 VOC 36-54 NOx	28 million

.08 ppm, 8 hour, 1 AX	$0.2 - $3.8	$0.1 - $2.1	$6.3	$(6.2) - $(4.2)	37 areas	515-783 VOC 117-178 NOx	53 million

1 This scenario represents a very inefficient approach for meeting the standard. The reader should refer to the regional control scenario for a better estimate of likely costs.
2 Numbers in ( ) denote negative values.
3 See the Cost Chapter for a more detailed treatment of residual nonattainment.
4 The current standard is assumed to be approximately equal to an 8-hour, .09 ppm, 2AX alternative.

I. INTRODUCTION, ANALYTICAL SCOPE AND LIMITATIONS

I(A) INTRODUCTION

The Clean Air Act directs the Environmental Protection Agency (EPA) to identify and set national standards for pollutants which cause adverse effects to public health and the environment. EPA is also required to review the health and welfare-based standards at least once every five years to determine whether, based on new research, revisions to the standards are necessary to continue to protect public health and the environment. Recent scientific evidence indicates that ground-level ozone not only affects people with impaired respiratory systems (such as asthmatics), but healthy adults and children as well. The new studies taken into account during this latest review show health effects at levels below that of the current standard (0.12 ppm, 1-hour form). In particular, active children and outdoor workers exposed for 6-8 hours of ozone levels as low as 0.08 ppm may experience several acute effects such as decreased lung function, acute lung inflammation, and premature aging of the lung. Recent studies also provide evidence of an association between elevated ozone levels and increases in hospital admissions; and animal studies indicate repeated exposure to high levels of ozone for several months can produce permanent structural damage in the lungs. As a result of the most recent review process, EPA proposing to revise the primary (health-based) and secondary (welfare-based) National Ambient Air Quality Standards (NAAQS) for ozone. Pursuant to Executive Order 12866, this draft Regulatory Impact Analysis (RIA) assesses the costs, economic impacts, and benefits associated with the *implementation* of these and alternative NAAQS for ozone.

In setting the primary air quality standards, EPA's first responsibility under the law is to select standards that protect public health. In the words of the Clean Air Act, for each criteria pollutant EPA is required to set a standard that protects public health with "an adequate margin of safety." As interpreted by the Agency and the courts, this decision is a *health-based* decision that specifically is *not* to be based on cost or other economic considerations. This reliance on science and prohibition against the consideration of cost does not mean that cost or other economic considerations aren't important or can be ignored. In fact, the Agency believes that consideration of cost is an essential decision making tool. However, under the health-based approach required by the Clean Air Act, the appropriate place for cost and efficiency considerations is during the development of implementation strategies, strategies that will allow communities, to meet the health-based standards. Through the development of national emissions standards for cars, trucks, fuels, large industrial sources and power plants, for example, and through the development of appropriately tailored state and local implementation plans, the implementation process is where decisions are made -- both nationally and within each community -- affecting how much progress can be made, and what time lines, strategies and polices make the most sense.

In other words, this draft RIA and associated analyses are intended to generally inform the public about the potential costs and benefits that may result when the proposed revisions to the ozone NAAQS are implemented by the States, but are not relevant to establishing the standards themselves. Ozone has an adverse effect on plants, animals, and human health. Ozone is created when its two primary components, volatile organic compounds (VOCs) and oxides of nitrogen (NOx), combine in the presence of sunlight under specific meteorological conditions. Because ozone cannot be formed without VOC and NOx, these two classes of compounds are often referred to as *precursors*, which are, for the most part, emitted directly into the atmosphere from a combination of natural and anthropogenic sources. Attempts to decrease ozone pollution in the United States has been confounded by a number of factors, including the inherent non-linearity of the photochemical smog mechanism, the contribution of natural precursor emissions, long range transport of ozone and its precursors (primarily NOx), meteorological variability, the general lack of essential data (primarily inventory related), and the limitations of current modeling tools.

I(A)(1) TITLE AND DESCRIPTION

This report is titled: The Ozone NAAQS Regulatory Impact Analysis for 40 CFR Part 50 National Ambient Air Quality Standard for Precursors of Ozone, prepared in fulfillment of the requirements of the Unfunded Mandates Reform Act (UMRA), and Executive Orders (EO) 12291 and 12866. This report was completed according to the guidelines established in the EPA Guidelines for Implementing the Regulatory Flexibility Act, revised April 1992 by the Office of Policy, Planning, and Evaluation, Office of Regulatory Management and Evaluation.

The Unfunded Mandated Reform Act of 1995 (P.L. 104-4))E.O. 12875, Enhancing Intergovernmental Partnerships, 12/24/94), in Title II, section 201, directs agencies "unless otherwise prohibited by law [to] assess the effects of Federal regulatory actions on State, local, and tribal governments, and the private sector . . ." Section 202 of Title II directs agencies to provide a qualitative and quantitative assessment of the anticipated costs and benefits of a Federal mandate resulting in annual expenditures of $100 million or more, including the costs and benefits to State, local, and tribal governments, or the private sector. Since the NAAQS themselves do not establish any requirements applicable to State, local, and tribal governments, or the private sector, the Unfunded Mandates Reform Act does not apply. However, the Agency has conducted general analyses of the potential impacts of control measures the States might adopt to attain the proposed NAAQS, and has included those analyses in this RIA. Executive Order 12875 "Enhancing the Intergovernmental Partnership" (10/26/93) was also taken into account in the development of this RIA.

The Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA) was developed to assure that Agencies consider the impacts of their rulemakings on small entities. Since the NAAQS themselves do not establish any requirements applicable to small entities, SBREFA does not apply to this rulemaking. However, the Agency has conducted general analyses of control measures the States might adopt to attain the proposed NAAQS, and has included those analyses in this RIA.

I(A)(2) SCHEDULES FOR OMB REVIEW

The Agency anticipates this report will be presented as part of a compete package to OMB in early November 1996. OMB review will proceed through the month of November. Following OMB review, the Agency anticipates publication of the new ozone NAAQS under 40 CFR part 50 in late November of 1996, with a targeted promulgation time of late June 1997.

I(B) ANALYTICAL SCOPE

The current development of a new NAAQS for ozone has two separate and distinct components: the development of the standard itself, which is codified under 40 CFR part 50, and the development of cost effective implementation strategies to manage that new standard, codified under 40 CFR part 51. Under ideal circumstances, the schedule of NAAQS development would permit a single RIA and ICR to determine the overall impact of the combined 40 CFR parts 50 and 51 rulemakings. However, resource and scheduling constraints including the additional time for Federal Advisory Committee Act (FACA) requirements preclude a unified approach to the NAAQS analysis. Consequently, the regulatory analysis associated with the development and implementation of a new ozone standard has been broken into two separate components. This RIA analyzes the development of a new standard under 40 CFR part 50. By June 1997, a second RIA and ICR will follow this RIA and will analyze the implementation of that new standard under 40 CFR part 51, scheduled to be proposed in June 1997. Therefore, for the same post-control ozone concentrations, the results in the present analysis are likely to overstate the actual costs and understate the actual benefits which derive from the implementation process. While the analysis of implementation strategies will probably show lower costs and lower levels of residual nonattainment, the level of uncertainty associated with these results is much higher.

This RIA establishes a baseline air quality in 2007 which incorporates (1) the full implementation of the Clean Air Act Amendments of 1990 (CAAA), (2) the effects on air quality that derive from economic and population growth, and (3) the beneficial effects on air quality that the Agency expects will result from a series of current efforts to provide regional level strategies to manage the long range transport of NOx. In particular, the thirty-seven Easternmost States have banded together to form the Ozone Transport Assessment Group (OTAG) [1], which is investigating alternative regional strategies similar to the Ozone Transport Region (OTR) [2] Memorandum of Understanding (MOU), which requires a 0.15#/MBtu NOx cap on utility and fossil fuel boilers and a California styled Light Emission Vehicle (LEV) program in all of its member States. Such programs would, upon implementation, reduce the affect of long range ozone precursor transport. Following the application of regional strategies in the East, this analysis approximated 2007 air quality to identify areas where ozone

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1 The Ozone Transport Assessment Group consists of: Alabama, Arkansas, Connecticut, Delaware, the District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Vermont, Virginia, West Virginia, and Wisconsin. Figure VI-8 in Chapter VI of this RIA displays the OTAG region. See Figure VI-1 for a map of the OTR and OTAG States.

2 The Ozone Transport Region (OTR) contains part or all of eleven States, plus the District of Columbia. The eleven States are: Maine, Vermont, Connecticut, New Hampshire, Massachusetts, Rhode Island, New York, New Jersey, Maryland, Pennsylvania, and the northwestern counties of Virginia.

concentrations above the standard may remain. The RIA's analytical team applied additional measures to those areas, following current implementation practices (Section 110 (a) subpart (2) of the Act).

While the above scenario provides information based on the best approximation of the expected air quality in 2007, the regional efforts that have been included have not been fully developed. Although regional strategies represent the current thinking of ozone managers across the country, there is a chance that these strategies will not be implemented. If that were to happen, this RIA's air quality estimates for the analytical year would understate the level of ozone. Therefore, for completeness, the analysis includes a discussion of the costs and benefits associated each alternative *without* the imposition of a regional strategy. For convenience in discussion, the baseline for this analysis will be called the "Regional Control Scenario" (RCS), and the sensitivity analysis performed without the regional strategies will be called the "Local Control Scenario" (LCS).

The current primary NAAQS is expressed in a one expected exceedance form, applied on a site-by-site basis. Since promulgation of the current NAAQS in 1979, a number of concerns have been raised about the one expected exceedance form, including its stability *vis a vis* attainment status; data handling conventions, including procedures for adjusting for missing data; and the evaluation of air quality on a site-by-site basis rather than some form of averaging across monitoring sites. Section V.I. of the Staff Paper discusses these issues in detail. While the adequacy of public health protection remains the foremost consideration in evaluating alternative forms of the primary standard, CASAC recommended investigation of alternative forms of the primary standard which may provide added stability in determining attainment status. Consequently, the Administrator has focused consideration on (1) revising the primary NAAQS to allow for multiple (up to five) expected exceedances per year, averaged over three years; and (2) adopting a concentration based statistic, such as the three year average of the nth-highest daily maximum eight hour average.

After carefully considering the information presented in the Criteria Document and the Staff Paper, the advice and recommendations of CASAC, and for the reasons discussed in the ANPR, the Administrator proposes replacing the existing one hour primary standard with an eight hour, 0.08 ppm primary standard. The proposed 0.08 ppm eight hour standard would be met at an ambient air quality monitoring site when the three year average of the annual third highest daily maximum eight hour average ozone concentration is less than 0.08 ppm, subject to data handling conventions specified in the proposed revisions to Appendix H of 40 CFR part 50.

This RIA examines five standards incremental to the costs, benefits, and economic impacts associated with applying all necessary and available controls to achieve the current (1H1EX-120)[3] standard in 2007. These alternative standards include: an eight hour five exceedance 0.08 ppm

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3 The shorthand terms in parentheses are consistent with those used in the Staff Paper (c.f., Figure V-7, p. 92). The first term in the shorthand, XH, refers to the number of hours used for averaging ozone concentrations. The next term, YAX or YEX, indicates two things: the "Y" term indicates the number of occurrences greater than the proposed level which can take place **before** triggering nonattainment; the "A" indicates the standard employs a concentration based averaging of the highest daily maximum ozone concentrations, and the "E" indicates the standard employs an expected exceedance form, similar to that which is being used by the current standard. The last term indicates the level of the standard in part per billion.

(8H5EX-80) form; an eight hour concentration based fifth highest daily maximum 0.08 ppm (8H4AX-80) form; an eight hour concentration based second highest average daily maximum 0.08 ppm (8H1AX-80) form; an eight hour 0.09 ppm form set at no more than the third highest average daily maximum ozone concentration; and an eight hour 0.07 ppm form set at no more than the fifth highest average daily maximum ozone concentration. While numerous other alternatives were examined by the Agency and CASAC, the Agency believes the set of standards chosen for analysis provides sufficient range for RIA purposes. The three eight hour 0.08 ppm alternatives analyzed by this RIA allow for comparisons between alternative forms of the standard at the same level and between different exceedance levels within the same form of the standard. While a complete examination of the 0.09 ppm and the 0.07 ppm alternatives may have provided some additional insight, resource constraints precluded the analysis of additional alternative standards. However, the staff analyzed existing monitored data against each of the five alternative standards and has concluded that, for analytical purposes: (1) the 0.09 ppm alternative is similar to the current 1H1EX-120 standard, and (2) the 0.07 ppm alternative provides a level of protection similar to the 8H1AX-80 form. This RIA does not directly analyze the proposed ozone primary standard. Instead, it provides upper and lower bounds to the expected costs, benefits, and economic impacts associated with the proposed standard, given the implementation of current command-and-control strategies. This RIA also discusses one alternative form of the ozone secondary standard.

The remainder of this chapter discusses the analytical limitations which surround this RIA. Chapter II discusses the background of the ozone NAAQS and the need for regulatory action. Chapter III discusses the alternatives examined in this RIA as well as a discussion of regulatory alternatives not taken. This RIA's methodology can be found in chapters IV and V, and Chapter VI discusses the projected costs and scope of each alternative NAAQS. Chapters VII and VIII provide an overview of potential economic impacts which could be derived by each alternative standard, given the implementation of current command-and-control strategies. Chapter IX describes the health and welfare benefits of each alternative standard under the framework of this analysis' limitations. The chapter presents benefits for full attainment, as well as for a level of attainment which approximates the level of control available within this analysis. Chapter X brings the benefits and costs discussions together for comparison.

I(C) LIMITATIONS OF SEGREGATED ANALYSES FOR THE OZONE AND PARTICULATE MATTER NAAQS

Concurrent with the review of the ozone NAAQS, the Agency is also reviewing the NAAQS for PM. There are many similarities between these two pollutants. Ideally, the RIA would have conducted its economic analysis taking this jointness into account. However, since each NAAQS review is a separate regulatory decision, the health effects and scientific information for each pollutant need to be judged separately and on their own merits. Furthermore, the Agency is in the process of developing the scientific tools and models needed to assess the interactions of these pollutants.

Concurrent with the review of these two NAAQS, EPA has requested the assistance of stakeholder groups to help design a new implementation approach to controlling PM and ozone. This stakeholder group has been charged to evaluate new approaches to controlling these pollutants, focusing on the interaction of these pollutants in the atmosphere. As part of this process, EPA will strive to perform an integrated analysis for the proposal of the implementation package in June 1997. A more fully integrated analysis will be available in subsequent stages of the implementation process. The reasons for doing an integrated analysis follow.

While not all attributes of ozone and PM are linked, important commonalities exist between ozone and PM which provide the technical and scientific rationale for integrated analysis. Similarities in pollutant sources, formation, and control exist between ozone and PM, in particular with respect to the fine fraction of particles addressed by the current PM NAAQS. These similarities include:

(1) atmospheric residence times of several days, leading to regional-scale transport of the pollutants,
(2) similar gaseous precursors, including NOx and VOC, which contribute to the formation of both ozone and PM in the atmosphere,
(3) similar combustion-related source categories, such as utilities, industrial boilers, and mobile sources, which emit particles directly as well as gaseous precursors of particles (e.g., SO_2, NO_x, VOC) and ozone (e.g., NO_x, VOC), and
(4) similar atmospheric chemistry driven by the same chemical reactions and intermediate chemical species which often favor both high ozone and fine particle levels.

These similarities provide opportunities for optimizing technical analysis tools (i.e., monitoring networks, emission inventories, air quality models) and integrated emission reduction strategies to yield important co-benefits across various air quality management programs. Integration could result in a net reduction of the regulatory burden on some source category sectors that would otherwise be impacted separately by ozone, PM, and visibility protection control strategies. However, it is not possible at this time to perform a fully integrated benefit-cost analysis. Among the difficulties in performing such an integrated analysis are: the significant differences in methodologies used for the two pollutants (e.g., air quality models); data are not currently available to assess the atmospheric interactions of these pollutants; and the control cost estimates presented in each RIA were developed from different bases and, therefore, cannot be directly compared, attributed to one pollutant or the other, or aggregated. Moreover, efforts to develop integrated implementation strategies have not been completed.

Separate analyses of the ozone and PM RIAs may cause misinterpretation of the total benefits, costs, and economic impact estimates from each RIA. For example, control of ozone precursors (VOC and NO_x) could result in reduced PM concentrations via reductions in organic and nitrate aerosols. Thus, the total benefits associated with ozone precursor controls may include an indirect component associated with the benefits of reducing adverse effects caused by PM and the cost savings associated with not having to impose as stringent PM controls as would otherwise be necessary to meet the PM NAAQS. To the extent that such indirect benefits exist, the benefit estimates presented in the separate ozone RIA may understate the actual total benefits accruing from ozone precursor controls.

Additionally, the PM RIa may overstate benefits and costs if PM reductions are achieved through controls intended to reduce ozone. Similarly, ozone and PM nonattainment areas and air quality management practices overlap, making it difficult to attribute costs when controls reduce both ozone and PM concentrations. Ozone and PM co-control may result in duplication of control cost estimates used in the separate RIAs, resulting in over- or underestimation of costs depending on the types and numbers of control measures selected. Table I-1 lists some common control measures and source categories.

One of the other major limitations which affects the results of this RIA is the assumption of the current implementation approach to measure the cost of attaining the new standards. The strategies used are limited in part because of our inability to predict the breadth and depth of the creative approaches to implementing these new NAAQS, and in part by technical limitations in modeling capabilities. This limitation, in effect, forces costs to be developed based on compliance strategies that reflect the suboptimal approaches to implementation, and therefore those that likely reflect higher potential costs for attaining the new standard. This required approach renders the result specifically useful as an incentive to pursue lower cost options, but not as a helpful indicator of likely costs.

It is important to recognize here that if new ozone or particulate standards are finalized under the Clean Air Act, the Act allows for substantial new flexibility in the development of implementation strategies, both for control strategies as well as schedules. To the extent that it is warranted, the Act allows for an extension of attainment deadlines as well. This new flexibility may also mean the development of different patterns of designations, and moving away from the traditional attainment-nonattainment delineations.

Even under the current standards, the Agency has begun to put an emphasis on strategies that can use the marketplace to reduce costs, utilize national strategies where they make sense, and that can look to regional and other cooperative approaches -- so that we maximize

TABLE I-1
PM-OZONE INTEGRATED CONTROL MEASURES

Control Measure	Examples of Applicable Source Category(ies)
Reformulated gasoline	Highway and non-road vehicles-gasoline
Reformulated diesel fuel	Highway and non-road vehicles-diesel
Enhanced inspection/maintenance	Highway vehicles-gasoline
Air/fuel adjustment + ignition timing retardation	Internal combustion engines (natural gas)
Low emission vehicles	Highway vehicles-gasoline
Vapor balance (Stage I)	Service stations (fuel truck unloading)
Selective/non-selective catalytic reduction	Utility, industrial, & commercial-institutional boilers; gas turbines; nitric acid mfg.; internal combustion engines; process heaters; cogeneration; municipal & medical waste incinerators; iron & steel mills
Low-NO_x burners	Utility, industrial, & commercial-institutional boilers; process heaters; co-generation; residential natural gas; iron & steel mills; cement mfg.

VOC add-ons (incineration, adsorption, condensation, etc.)	Aircraft/marine/paper/misc. surface coating; web offset lithography; synthetic fiber mfg.; gasoline bulk terminals
Coating reformulation	Wood product/furniture
California Air Resources Board (CARB) best available retrofit control technology (BARCT) limits/Federal implementation plan (FIP) rule	Automobile refinishing
Product reformulation	Aerosols
VOC fugitive controls	Petroleum refineries; synthetic organic chemical mfg.

efficiencies and minimize costs throughout the pollution control system. EPA and a large number of states are already working in this direction through the Ozone Transport Assessment Group, through the Ozone Transport Commission in the Northeast and through our own efforts to encourage market approaches for ozone precursors. We also are working with Western States through the Grand Canyon Visibility Transport Commission, which is addressing the visibility impacts of both ozone and particles.

Specific to new standards, EPA also has established a formal advisory committee under the Federal Advisory Committee Act. The specific purpose of the broad-based stakeholder group is to advise EPA on ways to develop innovative, flexible, practical and cost-effective implementation strategies, and to advise us directly on transitional strategies as well.

This group has specifically been tasked with consideration of strategies that would allow the future integration of ozone, PM, and regional haze control programs. This approach is intended to develop control strategies that recognize the significant overlap and similarities that exist among these pollutants as mentioned above.

These similarities clearly provide management opportunities for optimizing and coordinating monitoring networks, emission inventories and air quality models, creating opportunities for coordinating and minimizing the regulatory burden for sources that would otherwise be required to comply with separate controls for each of these pollutants.

Significant shortcomings also exist as to the data available for these analyses. Existing emissions inventories and modeling to date, either on a national scale, or on an aggregated basis, simply do not provide a sufficient analytical basis from which to draw accurate results. Projections concerning which areas will be classified as nonattainment can only be developed through extrapolation from existing ozone data -- an imprecise exercise at best -- and through the use of very uncertain modeling exercises. For example, at the time this analysis was begun, the best available inventory of VOC and NOx emissions was based on the Aerometric Information Retrieval System (AIRS) Interim 1990 inventory, which requires reporting of only sources greater than one hundred tons per year of VOC or NOx. Many sources, while contributing to the overall ozone problem, do not report to AIRS and, therefore, were not part of this analysis' inventory. Shortcomings exist for modeling as well. The Regional Oxidant Model (ROM) was the best ozone modeling tool available for this RIA. However, the ROM model applies to a rectangular grid which includes all or part of the thirty seven states in the East. Predicting ozone concentrations in the West based upon modeled results in the East reduces the reliability of this RIA's results. The combination of these uncertainties must inevitably provide uncertain results.

And finally, the nature of these kind of analyses is that of a snapshot in time. The cost of implementing these standard revisions in the first few years will mainly be related to planning, strategy development and creating state implementation plans. Therefore, we selected a year more reflective of the implementation of a new standard. The year 2007 was chosen because most of the mandatory CAAA requirements will have fully taken effect and most areas currently in violation are expected to achieve attainment with the current NAAQS standard by this year. Analysis results are presented for this single future year because results are based on air quality modeling performed for a single "representative" year. Multi-year air quality modeling was not feasible because of resource constraints. Moreover, the snapshot approach simplifies the presentation and interpretation of results. The limitations imposed by this snapshot approach are particularly troublesome in this case, primarily because of two reasons.

First of all, in terms of developing strategies or technologies, a decade can see many changes. For example, relative to air pollution control policy, since 1987 we have seen large scale revisions of the Clean Air Act - including complete rewrites of nonattainment, acid rain and air toxics policies - the Intermodal Surface Transportation and Efficiency Act, and the Energy Policy Act. Recently, we have also seen the introduction of utility deregualtion at the state and national level. All of these actions, both together and individually, are having important and, in some cases dramatic, effects on air quality.

In terms of technology, in the last decade we have seen the introduction of three generations of cleaner gasoline (i.e. low RVP, oxygenated and reformulated fuels), cleaner diesel fuels, the introduction of cleaner vehicles (such as electric vehicles), dramatic improvements in scrubber technology for sulfur dioxide controls, the development of replacements for phased out CFC's, far more cost-effective ways to control auto tail-pipe emissions and the development of on-board diagnostic equipment to assure those cleaner standards continue to be met over time.

Relative to attainment of national ambient air quality standards, since 1990 alone we have seen more than half of the areas in violation of the standards for ozone and carbon monoxide begin to meet the standards, many actually ahead of schedule. Moreover, the costs associated with many of these efforts are less than was estimated, even as late as 1990.

Therefore, in the case of air pollution control, ten years is a very long time over which to carry assumptions. Furthermore, a 2007 snapshot does not allow sufficient time for all areas to reach attainment, even under the current standard. Given the likelihood that new standards will result in additional time for some areas, it is clear that some areas will not be required to be in attainment by 2007. This analysis recognizes this by not arbitrarily forcing all areas to reach attainment in 2007 by the use of extreme control measures recognizing that such extreme measures are unlikely ever to be put in place. The reader should keep all of the above limitations in mind when reviewing and interpreting the results presented below.

(D) ANALYTICAL LIMITATIONS

Presented below are a number of key analytical limitations. They are not presented in any particular order, nor is any relative ranking of importance or impact to be implied.

Flexibility: Except for the provision for regional NOx controls in the Eastern United States, this RIA does not take into account any potential changes to the implementation process which might provide market based or other flexible programs to States, nonattainment areas, or sources. These are considerations which have been left for the 40 CFR part 51 analysis. Consequently, this analysis concentrates on alternative forms and levels of the primary and secondary ozone standard under the current implementation paradigm set out in subpart (2). Therefore, the results found in this RIA will be (a) incomplete, due to the problem of residual nonattainment, and (b) more burdensome than the final results, once the 40 CFR part 51 implementation process has been completed. Because the reported costs of this RIA do not capture all the costs of full attainment, the first restriction causes this analysis to understate the true costs of attaining any given standard. The second forces the analysis to artificially overestimate the true regulatory impact of the proposed ozone standard. This is due to the restrictive nature of the subpart (2) requirements which form the basis of implementation for the proposed alternative NAAQS.

In the 40 CFR part 51 RIA, several subpart (2) implementation requirements specific to the current standard will be dropped, allowing for economic creativity and flexibility in how the Agency approaches management of the new standard. EPA expects these changes will reduce the cost of available reductions, increase the amount of ozone removed, and decrease the size and number of residual nonattainment areas. However, until the completion of the implementation stage of the ozone NAAQS, the results of this RIA should be considered only an intermediate step in the overall NAAQS development process.

Modeling Limitations: With respect to the part 50 ozone NAAQS analysis, several significant shortcomings in the data must be identified. First, the ozone management process within the EPA is made up of a series of independent but interrelated components. Each of these components follows its own procedures for the gathering, verification, and dissemination of data (emissions inventories, source inventories, monitoring data, etc.) often times resulting in data incompatibility. The following is a list of the major considerations the RIA team identified for this analysis. For many of these issues, we anticipate performing sensitivity analyses to determine the relevant ranges of uncertainty embodied by each. However, these sensitivity analyses will be deferred until the second half of this NAAQS analysis when the part 51 implementation effects can be more accurately defined.

<u>The Interim 1990 Inventory and the 2007 Base Case Inventory</u>: (1) Bureau of Economic Analysis (BEA) Growth Factors: Emissions for stationary (point and area) non-solvent non-utility sources for 1990 and 2007 were projected from the 1985 National Acidic Precipitation Assessment Project (NAPAP) Inventory using BEA growth factors. Consequently, emissions for some sources could be either over or underestimated depending on how accurate the BEA growth factors reflect changes in source emissions over time. In addition, BEA factors may not accurately reflect growth in nonattainment areas. BEA factors may be a good surrogate for state-level emissions but not for estimating growth on an individual point source level.

(2) Emission Factors: For many of the stationary source categories in the inventory, emission factors have been updated since 1990. These changes may significantly change emission estimates for some source categories. In general, the NAPAP area source inventory utilized a top-down approach by multiplying an activity indicator by an emission factor and then allocating emissions from the national to the county level. The direction and magnitude of this cannot be determined within the scope of this RIA.

(3) Area Source Inventory Limitations: The area source inventory accounts for emissions not included in the point source inventory. However, area sources are harder to identify than point sources and their estimation emissions contains a high degree of uncertainty. Most emission estimates for this RIA were derived from demographic data. For example, this RIA estimates some area source emissions at the national level, utilizing a mass balance approach. This national value was then allocated to the county level using County Business Patterns data. Because area sources are generally small, the overall impact of this caveat will also be small.

(4) Scope of Applicability: Preparation of the 2007 base case scenario for the cost and economic impact analyses incorporated the effects of control measures that would be implemented by 2007. The projected coverage for some measures have diverged from their predicted values since the base case scenario was finalized. For example, the Base Case Inventory was created when it was generally believed that Pennsylvania would apply some sort of Statewide reformulated gasoline program. Since that time, the only area that has adopted that measure is Philadelphia. These divergences operate to both increase and decrease VOC and NOx inventories, depending on the control measure in question. The magnitude and direction of these divergences are beyond the scope of this RIA.

(5) Rule Effectiveness: The Agency assumed an eighty percent rule effectiveness (RE) rate for most stationary VOC sources equipped with an emissions control system. For some areas, such as Baton Rouge, RE improvements accounted for as much as sixty percent of the available VOC emission reductions. However, for some source categories, current work on the Compliance Assurance Monitoring Rule indicates the RE level may actually be ninety percent or higher and that it varies significantly across control measures. Therefore, estimated reductions from rule effectiveness improvements may be overstated. Adjusting these RE estimates to accommodate current information would (1) reduce the baseline ozone concentration for a given area, (2) reduce the need for and the availability of control measures for ozone management, (3) decrease marginal costs and benefits in identified nonattainment areas[4], and (4) change the number of residual nonattainment areas. The NAAQS analytical team plans to adjust the rule effectiveness control measure as a part of its inventory adjustment for the part 51 analysis.

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4 However, given the level of uncertainty within this analysis, available air quality models may not be sensitive enough to change in response to changes in VOC inventories due to placing RE reductions in the baseline or the inventory of available controls. Therefore, the removal of RE VOC reductions from the inventory could require the application of other controls to take their place. These new controls, by design, would cost more than the RE reductions.

Meteorology: Meteorology affects the predicted air quality in a given area because the concentration of ozone in the troposphere depends on emissions and meteorology. While the Regional Oxidant Model (ROM) factors into account both meteorology and emissions when it develops expected air quality values, it uses the same (1987) meteorology for each scenario, which causes a significant degree of correlation between any two ROM modeled years, even if emission levels differ significantly. While this is not necessarily wrong, this treatment of meteorology should be taken into consideration when interpreting ROM data.

The Regional Oxidant Model: ROM does not model the entire contiguous United States. It is limited to a roughly rectangular grid formed by 47° and 26° North Latitudes, and 67° and 99° West Longitudes. While this area encompasses more than three quarters of the area having monitored ozone exceedances, it cannot be used to predict ozone in the Western United States, nor is there an analogous emissions based model available which can be used to predict ozone concentrations in the entire non-ROM domain. Lees important from a cost perspective, crop loss benefits calculations require the application of a geographically based national ozone model. Finally, ROM does not model an entire year. Instead, ROM estimates ozone concentrations in just the three month period during the summer when ozone concentrations are the highest. While this is a lesser problem for the cost and economic impact components of this RIA, the effect of this limitation may be to underestimate benefits throughout the remainder of the year.

Because the ozone NAAQS is a national rule, its national impacts had to be estimated over an entire year. This meant that either multiple models to predict the ozone concentrations had to be used, one for the ROM domain and others for the non-ROM domain and the remainder of the year not predicted by ROM; or a model which would serve as a reasonable predictor of ozone concentrations for the entire continental United States had to be found.

The Centroid Model: The analysts chose to apply one model across the entire country. However, the Centroid Model that was chosen has its own limitations, primarily based on the manner in which it creates its predicted values. The Centroid Model does not use emission factors. Instead, it is an interpolation model which establishes an ozone concentration value for a specific location (in this case, the geographic centroid of each county) based upon the observed concentrations found at the three nearest and surrounding monitors. To establish a link between observed 1990 monitored data) and expected ozone concentrations in the year 2007, the Centroid model used ROM predicted baseline emissions to develop monitor estimates for the year 2007. A full description of the Centroid Model methodology can be found in Chapter IV and the docket. Since the Centroid Method does not use emissions, it could not be used to directly verify the effectiveness of the targeted VOC and NOx reductions for a given area. The technical team plans to perform additional sensitivity runs for the current and proposed standards.

Residual Nonattainment: Under each of the standards examined, some areas may not reach attainment within the time frame of this analysis. Each analysis embodies a specific level of residual nonattainment. This level varies between standards such that the end points differ for each alterative standard. Therefore the measurable costs of each alternative do not necessarily reflect the true differences in costs between standards. The Staff Paper makes the assumption that the number of nonattainment counties can be an indicator of the relative equivalence of alternative primary standards from a risk perspective (c.f., p. A-21, Table A-4). To the extent that this assumption is true, the most reliable metric in this RIA for evaluating the relative nature of each alternative is the number of counties affected.

Analytical Endpoints: Residual nonattainment limits comparisons between control costs and monetized benefits. Given the NAAQS is a national standard, the appropriate measure of benefits should be full attainment nationwide. While this RIA presents full attainment benefits as a measure of the proposed NAAQS, there is no scientifically supportable method for determining the costs of full attainment. Therefore, this analysis understates costs by allowing for residual nonattainment while overstating monetized benefits when measured at full attainment. To accommodate this shortfall, this RIA also presents the benefits associated with the change in ozone associated with partial attainment in residual nonattainment areas. This value, while it corresponds to the costs of attainment in this analysis, must be viewed within the scope of the caveats listed here and in the remainder of this RIA.

Health Benefits Estimation: A significant short-coming of the health benefits analysis is the inability to quantify and/or monetize many benefit categories. A summary of these categories is presented in the executive summary as well as the benefits chapter of this RIA. The result of this short-coming is that the monetized benefit estimates presented in this RIA are an underestimate of the true benefits expected to result from attainment of the proposed ozone NAAQS. Compounding this underestimation is the limits of the analysis to only calculate health benefits associated with ozone reductions occurring in identified nonattainment areas. However, ozone precursors can be transported over large distances and therefore, emission reductions occurring inside identified nonattainment areas may reduce ambient ozone concentrations outside of those areas. Limiting the health benefits estimations to only inside of identified nonattainment areas leads to an underestimation of the monetized health benefits associated with the proposed ozone NAAQS. Last, one significant category of uncertainty associated with the health benefits analysis is the estimation of ozone-induced mortality. This RIA includes recent assessments of ozone-induced mortality that were not included in the ozone Criteria Document and Staff Paper. The high estimate of the monetized health benefits presented in this RIA is driven by the mortality results. Although the Agency recognizes that a high degree of uncertainty exists in the estimation of ozone-induced mortality, the evidence linking a causal relationship between ozone exposure and mortality is significant enough in these new studies to warrant inclusion of this category in this analysis.

Welfare Benefits Monetization: A significant number of welfare benefits categories remain unmonetized because no direct measure of their values exist. A summary of these categories is presented in the executive summary as well as in the benefits chapter of this RIA. As a result of this limitation, the monetized benefit estimates presented in this RIA are underestimated with respect to the benefits expected to result from attainment of the proposed ozone NAAQS. In addition, the monetized crop yield loss benefits estimated for partial attainment of a standard (recognizing residual non-attainment) results in an underestimation of the potential benefits accrued by a particular standard.

Other limitations specific to the analyses of crop yield loss monetization are: (1) the extrapolation of limited monitored air quality data to national air quality distributions; (2) the application of exposure-response functions from NCLAN open-top chamber studies extrapolated to 1990 ambient air exposure patterns and crop production; (3) the use of alternative non-NCLAN exposure-response functions for a variety of fruits and vegetables not included in the NCLAN studies; (4) the use of a quadratic rollback methodology to project the "just attain" air quality distributions without a direct link to an emissions control strategy; and (5) the use of economic models with inherent uncertainties.

I(E) CAVEAT

This economic analysis provides estimates concerning possible negative cost and employment impacts for certain industrial categories organized by SIC codes. As is noted in the relevant sections, these estimates are uncertain for two reasons: 1) They do not take into account the variety of localized or regional implementation strategies that may follow the setting of new standards. Such tailored strategies will likely serve to mitigate negative impacts on local industries, and 2) They do not account for growth in revenue and employment that also may result from additional pollution control equipment sales, or from substitutions that will transfer revenue from one industry to another (e.g., oil to natural gas). Regardless of these uncertainties, however, these estimates will be useful in guiding implementation activities, for they serve to pinpoint efforts to mitigate potential negative economic impacts.

I(F) REFERENCES

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U.S. Environmental Protection Agency. (1996b) Review of the national ambient air quality standards for ozone: assessment of scientific and technical information. OAQPS Staff Paper . Research Triangle Park, NC: Office of Air Quality Planning and Standards; EPA report no. EPA/4521R-96-007. Available from NTIS, Springfield, VA; PB96-203435.

II. STATEMENT OF NEED FOR THE PROPOSED REGULATION

II(A) INTRODUCTION

Congress passed the Clean Air Act to protect public health and the environment from the adverse effects of air pollution. This section briefly describes the need for regulation due to the nature of ozone pollution and summarizes the statutory requirements affecting the development and revision of the ozone NAAQS. The current development of a new NAAQS for ozone has two separate and distinct components: the development of the standard itself, codified under 40 CFR part 50; and the development of cost-effective implementation strategies to achieve the new standard, codified under 40 CFR part 51. Normally, the process of NAAQS development would be handled as a single entity, with only one RIA to determine the combined impacts of parts 50 and 51. However, resource constraints and FACA requirements within the Agency resulted in two separate phases. The phase which is assessed in this RIA pertains to the development of a new standard under part 50. The second phase, which pertains to the implementation of the new standard under part 51, will be analyzed in a separate RIA.

II(B) BACKGROUND

II(B)(1) LEGISLATIVE REQUIREMENTS AND JUDICIAL REQUIREMENTS

Two sections of the Clean Air Act (Act) govern establishment and revision of NAAQS. Section 108 (42 U.S.C. 7408) directs the Administrator to identify pollutants which "may reasonably be anticipated to endanger public health and welfare" and to issue air quality criteria for them. These air quality criteria are intended to "accurately reflect the latest scientific knowledge useful in indicating the kind and extent of all identifiable effects on public health or welfare which may be expected from the presence of [a] pollutant in the ambient air . . . ."

Section 109 (42 U.S.C. 7409) directs the Administrator to propose and promulgate "primary" and "secondary" NAAQS for pollutants identified under section 108. Section 109(b)(1) defines a primary standard as one "the attainment and maintenance of which, in the judgment of the Administrator, based on the criteria and allowing an adequate margin of safety, [is] requisite to protect the public health."[1] A secondary standard, as defined in section 109(b)(2), must "specify a level of air quality the attainment and maintenance of which, in the judgment of the Administrator, based on [the] criteria, is requisite to protect the public welfare from any known or anticipated adverse effects

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1 The legislative history of section 109 indicates that a primary standard is to be set at "the maximum permissible ambient air level . . . which will protect the health of any [sensitive] group of the population," and that for this purpose "reference should be made to a representative sample of persons comprising the sensitive group rather than to a single person in such a group." S. Rep. No. 91-1196, 91st Cong., 2d Sess. 10 (1970). The legislative history specifically identifies bronchial asthmatics as a sensitive group to be protected. Id.

associated with the presence of [the] pollutant in the ambient air." Welfare effects as defined in section 302(h) [42 U.S.C. 7602(h)] include, but are not limited to, "effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being."

The U.S. Court of Appeals for the District of Columbia Circuit has held that the "margin of safety" requirement for primary standards was intended to address uncertainties associated with inconclusive scientific and technical information available at the time of standard setting. It was also intended to provide a reasonable degree of protection against hazards that research has not yet identified. Lead Industries Association v. EPA, 647 F.2d 1130, 1154 (D.C. Cir. 1980), cert. denied, 101 S. Ct. 621 (1980); American Petroleum Institute v. Costle, 665 F.2d 1176, 1177 (D.C. Cir. 1981), cert. denied, 102 S. Ct. 1737 (1982). Both kinds of uncertainties are components of the risk associated with pollution at levels below those at which human health effects can be said to occur with reasonable scientific certainty. Thus, by selecting primary standards that provide an adequate margin of safety, the Administrator is seeking not only to prevent pollution levels that have been demonstrated to be harmful but also to prevent lower pollutant levels that may pose an unacceptable risk of harm, even if the risk is not precisely identified as to nature or degree.

In selecting a margin of safety, the EPA considers such factors as the nature and severity of the health effects involved, the size of the sensitive population(s) at risk, and the kind and degree of the uncertainties that must be addressed. Given that the margin of safety requirement by definition only comes into play at levels where there is no conclusive showing of adverse effects, such factors, which involve unknown or only partially quantified risks, have their inherent limits as guides to action. The selection of a particular approach to providing an adequate margin of safety is a policy choice left specifically to the Administrator's judgment. Lead Industries Association v. EPA, supra, 647 F.2d at 1161-62.

Section 109(d)(1) of the Act (enacted in 1977) requires that "not later than December 31, 1980, and at 5-year intervals thereafter, the Administrator shall complete a thorough review of the criteria published under section 108 and the national ambient air quality standards . . . and shall make such revisions in such criteria and standards and promulgate such new standards as may be appropriate . . . ." Section 109(d)(2) requires that an independent scientific review committee be appointed and provides that at corresponding intervals the committee "shall complete a review of the criteria . . . and the national primary and secondary ambient air quality standards . . . and shall recommend to the Administrator any new . . . standards and revisions of existing criteria and standards as may be appropriate . . . ."

II(B)(2) ESTABLISHMENT OF NAAQS FOR PHOTOCHEMICAL OXIDANTS

On April 30, 1971, the EPA promulgated NAAQS for photochemical oxidants under section 109 of the Act (36 FR 8186). Identical primary and secondary NAAQS were set at an hourly average of 0.08 parts per million (ppm) total photochemical oxidants not to be exceeded more than 1 hr per year. Scientific and technical bases for these NAAQS were provided in the document, Air Quality Criteria for Photochemical Oxidants (U.S. DHEW, 1970). The primary standard was based in part on several epidemiology studies conducted in Los Angeles, which reported a relationship between ambient oxidant levels and aggravation of respiratory disease. The secondary standard was based on evidence of acute and chronic vegetation injury and physiological effects, including growth alterations, reduced yields, and changes in the quality of plant products (U.S. DHEW, 1970, p. 6-18).

II(B)(3) REVIEW AND REVISION OF NAAQS FOR PHOTOCHEMICAL OXIDANTS

In 1977, the EPA announced (42 FR 20493) that it was reviewing the 1970 Criteria Document in accordance with section 109(d)(1) of the Act and, in 1978, published a revised Criteria Document (U.S. EPA, 1978). Based on the revised Criteria Document, EPA published proposed revisions to the original NAAQS in 1978 (43 FR 16962) and final revisions in 1979 (44 FR 8202). The primary standard was revised from 0.08 ppm to 0.12 ppm; the secondary standard was set identical to the primary standard; the chemical designation of the standards was changed from photochemical oxidants to ozone; and the form of the standards was revised from a deterministic form to a statistical form, which defined attainment of the standards as occurring when the expected number of days per calendar year with maximum hourly average concentrations greater than 0.12 ppm is equal to or less than one. The revised standards were upheld on judicial appeal. American Petroleum Institute v. Costle, supra.

In 1982 (47 FR 11561), the EPA announced plans to revise the 1978 Criteria Document. In 1983, the EPA announced (48 FR 38009) that review of primary and secondary standards for ozone had been initiated. The EPA subsequently provided a number of opportunities for public review and comment on drafts of the Criteria Document and associated Staff Paper (U.S. EPA, 1989). After reviewing the draft Criteria Document in 1985 and 1986, the CASAC sent to the Administrator a "closure letter" outlining key issues and recommendations indicating that it was satisfied with the final draft of the 1986 Criteria Document (U.S. EPA, 1986).

Following closure, a number of scientific articles and abstracts were published or accepted for publication that appeared to be of sufficient importance concerning potential health and welfare effects of ozone to warrant preparation of a Supplement to the 1986 Criteria Document (U.S. EPA, 1992). The CASAC, having already reviewed two drafts of the Staff Paper in 1986 and 1987, concluded that sufficient new information existed to recommend incorporation of relevant new information into a third draft of the Staff Paper.

The CASAC held a public meeting in 1988 to review a draft Supplement and the third draft Staff Paper. Major issues included the definition of adverse health effects of ozone; the significance of health studies suggesting that exercising individuals exposed for 6 to 8 hours to ozone levels at or below 0.12 ppm may experience lung inflammation and transient decreases in pulmonary function; the possibility that chronic irreversible effects may result from long-term exposures to elevated levels of ozone; and the importance of analyses indicating that agricultural crop damage may be better defined by a cumulative seasonal average than by a 1-hr peak level of ozone. In its closure letter of 1989 (58 FR 13018), the CASAC indicated that the Supplement and Staff Paper (U.S. EPA, 1989) "provide an adequate scientific basis for the EPA to retain or revise primary and secondary standards for ozone." With regard to the emerging database on exposures of 6 hours or more, CASAC concluded that such information could better be considered in the next review of the ozone NAAQS.

On October 22, 1991, the American Lung Association (ALA) and other plaintiffs filed suit under section 304 of the Act to compel the EPA to complete its review of the criteria and standards for ozone. The U.S. District Court for the Eastern District of New York subsequently issued an order requiring the Administrator to sign a Federal Register notice announcing its proposed decision on whether to revise the standards for ozone by August 1, 1992 and to sign a Federal Register notice announcing EPA's final decision by March 1, 1993.

On August 10, 1992 (57 FR 35542), the EPA published a proposed decision under section 109(d)(1) that revisions to the existing primary and secondary standards were not appropriate at that time. The notice explained (see 57 FR 35546) that the proposed decision would complete the EPA's review of information on health and welfare effects of ozone assembled over a 7-year period and contained in the 1986 Criteria Document and its Supplement. The notice indicated that the Administrator had not taken into account more recent studies on the health and welfare effects of ozone because these studies had not been assessed in the 1986 Criteria Document or its Supplement, nor had they collectively undergone the rigorous, integrative review process (including CASAC review) necessary to incorporate them into a new criteria document. Because that process and other necessary steps could not, in EPA's view, be completed in time to meet the March 1993 deadline for a final decision, the proposed decision was based on EPA's evaluation of key information published through early 1989, as contained in the 1986 Criteria Document and its Supplement; the 1989 Staff Paper assessment of the most relevant information in these documents; and the advice and recommendations of the CASAC as presented both in the discussion of these documents at public meetings and in the CASAC's 1986 and 1989 closure letters.

In view of the potential significance of the more recent scientific papers, as well as ongoing research on the health and welfare effects of ozone, the August 10, 1992 notice also announced the EPA's intention to proceed as rapidly as possible with the next review of the air quality criteria and standards for ozone. Shortly thereafter, the EPA's Environmental Criteria and Assessment Office (ECAO) formally initiated action to update the 1986 Criteria Document and its Supplement (57 FR 38832).

On March 9, 1993 (58 FR 13008), the EPA published a final decision concluding that revisions to the current primary and secondary NAAQS for ozone were not appropriate at that time. Given the potential importance of the new studies and the EPA's continuing concern about the health and welfare effects of ozone, the March 9, 1993 notice emphasized the Administrator's intention to complete the next review of the NAAQS as rapidly as possible and, if appropriate, to propose revisions of the standards at the earliest possible date. The Administrator subsequently adopted a substantially accelerated schedule for the next review (59 FR 5164).

The ALA sought judicial review of the March 1993 decision under section 307(b) of the Act. Noting that the Administrator intended to reconsider that decision as rapidly as possible in light of the more recent scientific information, EPA sought and was subsequently granted a voluntary remand of ALA's petition for review.

II(B)(4) CURRENT REVIEW OF OZONE NAAQS

As indicated above, ECAO initiated action to update the air quality criteria document for ozone in August 1992 (57 FR 38832). A series of peer-review workshops was held on draft chapters of the revised Criteria Document (CD; U.S. EPA, 1996a) in July 1993 (58 FR 35454) and September 1993 (59 FR 48063), and a first external review draft was made available for CASAC and public review on January 31, 1994 (59 FR 4278).

On November 18, 1993, ECAO and OAQPS discussed with CASAC (58 FR 59034) EPA's accelerated schedule for completing the ozone NAAQS review, formally published on February 3, 1994 (59 FR 5164). In December 1993, OAQPS completed an Ozone NAAQS Development Project Plan, which identified key issues to be addressed in the Staff Paper (U.S. EPA, 1996b)and the basis for the initial scientific and technical assessments planned to address the issues. OAQPS also met with a subcommittee of the CASAC in December 1993 (58 FR 59034) and March 1994 to discuss methodologies used in the exposure and risk assessments summarized in the Staff Paper.

The CASAC reviewed the first external review draft of the revised CD at a public meeting held on July 20-21, 1994 and made recommendations for revisions. At a public meeting held on March 21-22, 1995, the CASAC reviewed a second external review draft of the Criteria Document and a first external review draft of a portion of the Staff Paper. Following revisions of both CD and Staff Paper, an external review draft of the entire Staff Paper and Chapter 5 of the CD were reviewed at a public meeting held on September 19-20, 1995. Following that meeting, "closure letters" on the draft CD and the primary portion of the draft Staff Paper dated November 28, 1995 and November 30, 1995, were forwarded by the CASAC Chairman to the EPA Administrator. CASAC reviewed a revised version of the secondary standard portion of the draft Staff Paper on March 21, 1996, and a closure letter was sent from the CASAC Chairman to the EPA Administrator on April 4, 1996. The Staff Paper was made available to the public in June 1996 and the CD in July 1996.

I(C) MARKET FAILURES

In the absence of government regulation, market-oriented economic systems typically fail to prevent elevated levels of pollution in the environment because the environment is a public good. More specifically, individual sources treat the assimilative capacity of the environment as a "free good" resource to dispose of unused byproduct emissions. Under these conditions, emitters of pollutants and pollutant precursors do not internalize the full social cost of damages created by their own emissions. Ozone damages include increased morbidity and mortality; property damage from soiling, staining, and corrosion; and productive loss due to decreased worker efficiency, crop and livestock damage, and increased wear and tear on capital stocks. While subject to limitations in record keeping and other forms of uncertainty, all of these damages are measurable. In addition, ozone causes other damages which are much harder, if not impossible, to quantify. These damages include habitat loss, diminished biodiversity, reductions in aesthetic quality, option values, and existence values.

The divergence between the private cost of production and the social cost of production occurs because the source does not bear the full cost of its activities (market costs plus external damages). The outcome of the cost divergence is market failure, where as described in this case, the level of output is such that marginal social benefits are not equal to marginal social cost. The result is economic inefficiency, or a mis-allocation of society's resources; the polluting activity (e.g., the release of ozone precursors) occurs at too high a level in comparison to the optimally efficient situation, thus reducing the potential total benefits to society. Generally, command-and-control regulatory strategies do not attempt to correct for the divergence between social and private costs. However, regulatory strategies that do internalize the negative externality may not result in zero air pollution. Economic efficiency calls for abatement up to the point where additional abatement would cost more than the additional benefits would be worth to society.

In addition to government regulation, other potential mechanisms may be used to correct for the negative externality brought about by air pollution. Negotiations or litigation under tort and common law, in theory, could result in compensation to persons for the damages that they incur. However, two major obstacles block the correction by the private market for pollution-based inefficiencies and inequities. The first obstacle is high transaction costs when many people are affected by many pollution sources, as is typically the case with air pollution problems. Transaction costs of compensating those adversely affected arise and accumulate because the current and future injury to each individual must be appraised, the injury must be apportioned to each source, and damage suits or negotiations must be conducted. In an unregulated market, each source of precursor emissions and each affected person would have to litigate or negotiate. The transaction costs would be so high as to probably exceed the benefits of reduced air emissions. These obstacles suggest the need for another mechanism for solving air pollution problems.

The second obstacle to resolution by the private sector is due to the public good nature of air resource. There is no mechanism to limit anyone's access to cleaner air, so the benefits of cleaner air can be enjoyed by individuals whether or not they have paid for them. This is the classic "free rider" problem. Everyone has an incentive not to contribute resources for litigation or negotiation, thinking that he or she would freely benefit from the efforts of others. While regulatory intervention can mitigate the impacts of the types of market failures discussed above, they generally do not occur without imposing their own costs. Typically, these costs include administration, enforcement, and the redistribution of resources at all levels. The purpose of this report is to analyze, identify, and mitigate these regulatory costs.

II(D) THE NATURE OF THE AMBIENT OZONE AIR POLLUTION PROBLEM

Ozone has an adverse effect on human health, plants, and animals. Numerous and diverse health effects have been linked to ozone exposure in laboratory experiments, including lung inflammation, effects on lung host defense mechanisms, morphological (lung structure) effects, respiratory symptoms, pulmonary function decrements, changes in lung biochemistry, and genotoxicity.

Although these effects each have different physiological mechanisms, each effect is initiated by the preliminary interactions of ozone and ozone reaction products with fluids and epithelial cells in the respiratory tract. In addition, scientific literature has demonstrated an association between ozone exposure and: visible leaf damage, growth reductions and yield loss in annual crops, growth reductions in tree seedlings and mature trees, and effects that can have impacts at the forest stand and ecosystem level.

The "public good" characteristic of ambient air causes a failure of the market to promote an optimal level of air pollution control. The result of this market failure is that human health, plants, and animals experience adverse effects from elevated levels of ozone. The purpose of this proposed ozone NAAQS is to mitigate the effects of this market failure in order to provide further protection of human health, plants, and animals from the effects of ozone exposure.

II(D)(1) HEALTH CONSIDERATIONS

The current primary ozone NAAQS was set in 1979 with a 1-hr averaging time with the intention of protecting the public against the health effects associated with short-term (one- to three-hour) and prolonged acute (six- to eight-hour) exposures to ozone. At that time, the health effects potentially associated with longer-term ozone exposures which were not well documented. Since 1979, numerous researchers have investigated the health effects associated with short-term and prolonged acute exposures to ozone. Numerous controlled-exposure studies of human subjects engaged in activities (e.g., stationary cycling) involving heavy and moderate exertion provide a basis for quantitative concentration-response relationships between one- and three- hour ozone exposures and a variety of lung function parameters and respiratory symptoms. In addition, field and epidemiological studies now provide additional evidence of associations between one-hour ambient ozone levels and health effects ranging from respiratory symptoms and lung function decrements to increased hospital admissions for respiratory causes. However, the field and epidemiological studies have not been analyzed sufficiently as yet to determine whether the observed effects correlate as well or better with six- to eight-hour exposures as with the one- to three-hour exposures. In addition to these health effects, daily mortality studies have suggested a possible association between ambient ozone levels and an increased risk of mortality. More recent controlled-exposure studies have been conducted providing evidence that the same respiratory effects (i.e., lung function decrements and respiratory symptoms) occur when human subjects are exposed to ozone concentrations as low as 0.08 ppm while engaging in activities involving intermittent, moderate exertion for prolonged exposure periods of six to eight hours. These effects occur at lower concentrations of ozone and at less severe exertion levels than in the one- to three-hour exposure studies. Other effects, such as the presence of biochemical indicators of inflammation and reductions in pulmonary defense mechanisms, potentially leading to increased susceptibility to infection, have also been reported for prolonged exposures and, in some cases, for short-term exposures. Although the biological effects reported in laboratory animal studies can be extrapolated to human health effects only with great uncertainty, a large body of toxicological evidence exists which suggests that repeated exposures to ozone over periods of months to years can accelerate aging of the lungs and cause structural damage. The extent to which these effects might affect the quality of life of the elderly remains uncertain at this time.

The current one-hour averaging time is judged to adequately address acute health effects associated with exposures of between one and three hours because these effects typically begin to occur within the first hour of exposure, during moderate and heavy exertion. On the other hand, an eight-hour averaging time is judged to be more appropriate for addressing similar health effects, although of a larger magnitude, associated with six- to eight-hour exposures, since health effects typically build up over time in moderately exercising subjects, approaching a plateau somewhat beyond the 6.6 hour exposure periods for which most of the prolonged exposure studies have been conducted.

II(D)(2) WELFARE CONSIDERATIONS

In the area of welfare effects, especially in terms of agricultural productivity, the Staff Paper (EPA, 1996b) provides data and methodology for the valuation of damages to crops. In its review of welfare effects and valuation, the CASAC concluded that although absolute benefit values are uncertain estimates of crop losses, they provide relative incremental benefits associated with specific standards. Nevertheless, there are many sources of uncertainties inherent in such analyses.

Some of the most important caveats and limitations concerning the valuation of crop yield loss include: (1) the extrapolation of limited monitored air quality data to national air quality distributions; (2) the application of exposure-response functions from NCLAN open-top chamber studies extrapolated to 1990 ambient air exposure patterns and crop production; (3) the use of alternative non-NCLAN exposure-response functions for a variety of fruits and vegetables not included in the NCLAN studies; (4) the use of a quadratic rollback methodology to project the "just attain" air quality distributions without a direct link to an emissions control strategy; and (5) the use of economic models with inherent uncertainties.

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III. ALTERNATIVES EXAMINED

III(A) INTRODUCTION

This RIA examines five standards incremental to the costs, benefits, and economic impacts associated with applying all necessary and available controls to achieve the current (1H1EX-120) standard in 2007. These alternative standards include: an eight hour five exceedance 0.08 ppm (8H5EX-80) form; an eight hour concentration based fifth highest daily maximum 0.08 ppm (8H4AX-80) form; an eight hour concentration based second highest average daily maximum 0.08 ppm (8H1AX-80) form; an eight hour 0.90 ppm form set at no more than the third highest average daily maximum ozone concentration; and an eight hour 0.07 ppm form set at no more than the fifth highest average daily maximum ozone concentration. While numerous other alternatives were examined by the Agency and CASAC, the set of standards chosen for analysis provides sufficient range for RIA purposes. While a complete examination of the 0.90 ppm and the 0.07 ppm alternatives may have provided some additional insight, resource constraints precluded the analysis of additional alternative standards. However, for analytical purposes, the 0.90 ppm alternative is similar to the current 1H1EX-120 standard, and the 0.07 ppm alternative provides a level of protection similar to the 8H1AX-80 form. This RIA does not directly analyze the proposed ozone primary standard. Instead, it provides upper and lower bounds to the expected costs, benefits, and economic impacts associated with the proposed standard, given the implementation of current command-and-control strategies. This RIA also discusses one alternative form of the ozone secondary standard. The remainder of this chapter provides a complete description of these seven standards.

III(B) GENERAL DESIGN OF ALTERNATIVES

In selecting a primary standard for ozone, the Administrator must specify 1) averaging time, 2) ozone concentration (i.e., level), and 3) form (i.e., the air quality statistic to be used as a basis for determining compliance with the standard). The one hour averaging time specified in the current NAAQS was selected primarily on the basis of health effects associated with short-term (i.e., one to three hour) exposures, with qualitative consideration given to preliminary information on potential associations with longer exposure periods. Since that selection, substantial new health effects information has become available which demonstrates associations between a wide range of health effects and prolonged (i.e., six to eight hour) exposures below the level of the current one hour standard. Additionally, results from quantitative risk analyses show that attaining a standard with an eight hour averaging time reduces the risk of experiencing health effects associated with both one hour and eight hour exposures and an eight hour averaging time is more directly associated with health effects of concern at lower ozone concentrations than is the one hour averaging time. Based on the assessment of relevant scientific and technical information in the Criteria Document (EPA, 1996(a)), the Agency believes the present one-hour standard should be eliminated and replaced with an eight hour standard. Consequently, the Administrator proposes the primary ozone standard be expressed by comparing the three year average of the third highest daily maximum eight hour average ozone concentrations to the proposed level of the standard. An area would not be in compliance with the proposed standard when the three year average of the annual third highest daily maximum eight hour ozone concentration is greater than 0.08 ppm.

III(B)(1) THE CURRENT STANDARD (1H1EX-120)

The test for determining attainment of the current primary ozone standard specifies that the expected number of days per year on which the level is exceeded is to be less than or equal to 1.0 (values less than 1.05 rounded down) [1] , averaged over a three year period, and that specific adjustments are to be made for missing data. The attainment test specifies the "expected number" of days with concentrations above 0.12 ppm (i.e., exceedance days) is determined by calculating the average number of exceedances during the most recent three years, adjusting for missing monitoring days during the designated ozone season. All sites must meet the standard for the area to be designated in attainment of the ozone NAAQS.

As noted above, compliance with the ozone NAAQS is judged on the basis of expected exceedances. However, a simple attainment test that gives comparable results can be performed using the air quality design value. Given the expected exceedance form of the ozone NAAQS, the design value for the current standard is defined as "...the concentration with expected number of exceedances equal to one". In statistical terms, this is known as the characteristic largest value (CLV): the value which is exceeded once per year on average. With three complete years of data, a simple tabular estimate of the design value is the fourth highest daily maximum concentration measured during the three years. If this design value is less than or equal to the level of the standard, then the standard is attained, since if the design value is reduced to the level of the NAAQS, there will be three daily maximum concentrations greater than the standard, or one day per year on average. Similarly, for two years of data the design value is the third largest value, and the second largest for a single year of data. Ozone air quality modeling used for this RIA is limited to a single year's worth of modeled data, so this analysis employs the design value methodology to identify areas of expected nonattainment. Consequently, for the current standard, the single year's daily maximum ozone concentrations were rank ordered and the second highest expected concentration became that area's design value.

III(B)(2) ALTERNATIVE 8H5EX-80

This form is computationally the same as the current one hour expected exceedance standard except that five exceedances of the standard are allowed per year on average. If the design value for a

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1 Due to the Agency's rounding conventions, the standard is actually attained when the expected number of days per calendar year with maximum hourly average concentrations of 125 ppm is equal to or less than one. This rounding convention holds for all forms of the standard and throughout this RIA, a reference to any particular standard should be understood to include this 5 ppm rounding "buffer".

specific monitor is less than or equal to 85 ppm, the standard is attained. With three complete years of data, the design value based attainment test compares the *sixteenth* highest daily maximum eight hour concentration to the level of the standard (0.08 ppm). In other words, if the design value is reduced to the level of the NAAQS, there will be fifteen daily maximum concentrations greater than the standard, or five days per year on average. As with the current standard, modeling limitations require the use of a single year design value. Consequently, for analytical purposes, an area does not attain the NAAQS if its *sixth* largest ozone concentration is greater than or equal to 85 ppm.

III(B)(3) ALTERNATIVE 8H4AX-80

The 8H4AX-80 primary ozone ambient air quality standard is met at an ambient air quality monitoring site when the three year average of the annual second highest daily maximum eight hour ozone concentration is less than or equal to 0.08 ppm. Data completeness requirements for eight hour forms of the standard also apply. [2] The 8H4AX-80 standard is *not* met when the three year average of the annual fifth highest daily maximum eight hour ozone concentration is greater than 85 ppm.

III(B)(4) ALTERNATIVE 8H1AX-80

The average annual second highest daily maximum concentration standard is met at an ambient air quality monitoring site when the three year average of the annual second-highest daily maximum eight hour ozone concentration is less than or equal to 85 ppm. The primary standard is not met (i.e., the site is nonattainment) when the three year average of the annual second highest daily maximum eight hour ozone concentration is greater than 85 ppm (i.e., the average second highest average daily maximum concentration is 85 ppm or greater). In terms of design value, the 8H1AX-80 form is analogous to the current standard. The primary standard is not met when the second highest daily maximum ozone concentration is 85 ppm or greater.

III(B)(5) ALTERNATIVE 8H3AX-90

To fully address the range of the CASAC recommendations, this RIA established a concentration based 0.90 ppm form of the eight hour standard such that the number of average daily maximums which exceeded the standard would result in a standard slightly more protective than the current standard. Based upon monitored data, the Agency set the number of allowable average daily

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2 Data completeness requires that for the three year period at a monitoring site, daily maximum 8-hour average concentrations must be available for at least 90 percent, on average, of the days during the designated ozone monitoring season, with a minimum data completeness in any one year of at least 75 percent of the designated sampling days, provided there is no obvious pattern of missing data on ozone conducive days.

maximums greater than a 0.90 ppm standard at three. For analytical purposes, this RIA determined the affect of the 8H3AX-90 form of the standard is sufficiently close to that of the current 1H1EX-120 form of the standard that a separate analysis was not necessary. For this RIA, the discussion of the current standard should be considered representative of the expected effects of the 8H3AX-90 form. EPA plans to assess this assumption if warranted by public comments on the proposal.

III(B)(6) ALTERNATIVE 8H5AX-70

To address the other end of the CASAC recommended range, and to limit the additional analysis necessary to do it, the staff established a concentration based 0.07 ppm form of the eight hour standard such that the number of average daily maximums which exceeded the standard would approximate the affect expected from the most stringent 0.08 ppm form. Based upon monitored data, the number of allowable average daily maximums greater than a 0.07 ppm standard was set at five. Similar to what was established for the 8H3AX-90 form, the staff determined the affect of the 8H5AX-70 form of the standard is sufficiently close to that of the current 8H1AX-80 form of the standard that a separate analysis was not necessary. For this RIA, the discussion of the 8H1AX-80 standard should be considered representative of the expected effects of the 8H5AX-70 form.

III(C) THE SECONDARY STANDARD

The Ozone Staff Paper (EPA, 1996(b)) concludes consideration should be given to a new seasonal standard (in the form of a three month, twelve hour SUM06 index in the range of approximately 25 to 38 ppm-hours) should the Administrator determine that additional protection is needed beyond the substantial protection that is estimated to result from any of the recommended alternative primary standards. This recommendation is based on a substantial data base linking agricultural crop yield loss to ambient ozone exposures and to a growing scientific literature on damage to tree seedlings and ecosystems caused by exposures to low concentrations of ozone. Based on a thorough review of the latest scientific information, the Administrator is proposing a secondary standard that is identical to the proposed primary ozone NAAQS or the alternative described above at the 25 ppm-hours level.

III(D) OTHER ALTERNATIVES

Because this RIA deals with the current implementation strategy as defined under title I section 110(a) subpart 2 of the Act, there is little room for regulatory flexibility. However, within this RIA, the analysis incorporated some regional control scenarios which approximate the expected effects from current regional efforts as a second "layer" of baseline controls. However, the application of regional NOx controls in the Eastern United States does not constitute an exhaustive application of flexibility to the ozone implementation process. No additional flexibility was considered because subpart (2) restricts the analyst's ability to define nonattainment areas in terms of area and in the types of regulatory strategies that are applicable.

Based upon the classification of the nonattainment area, subpart (2) requires specific controls and targeted reductions prior to the area's mandated attainment date. Oftentimes, these requirements are more costly and less effective than other emission reduction alternatives which are readily available. Consequently, the analysis performed for this RIA should not be viewed as the "bottom line" because it does not represent this RIA's expectation of the true impact of the proposed primary and secondary ozone standards. Instead, this analysis should be considered an upper bound on the potential costs of the proposed ozone standard. Below, this section of the RIA discusses several alternative approaches not taken by this RIA and the reason behind those decisions.

III(D)(1) NO REGULATION

One alternative to changing the ozone standard would be to maintain the *status quo*. However, recent new scientific evidence examined by the Criteria Document and the Staff Paper indicate the current one hour standard does not provide an adequate level of protection as required by the Act. Consequently, the Administrator determined that an eight hour 0.08 ppm ozone standard provides the requisite degree of public health protection. Therefore, given the requirements of the Act for the Agency to provide an adequate level of public health protection, a "no action" alternative was not considered a reasonable alternative.

III(D)(2) MARKET ORIENTED APPROACHES

Current Agency efforts for ozone management through the application of market based mechanisms may be identified in the FACA process, but for the purposes of this RIA, such flexibility was not a viable consideration. Most economic incentive programs involve either items outside the scope of this analysis (e.g., taxes and fees) or could not be applied within the framework of the methodology used (e.g., trading schemes). Consequently, this RIA does not assess the impacts of such strategies, leaving their analysis until after the FACA committee makes its recommendations.

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IV. METHODOLOGY: ESTIMATING AIR QUALITY

IV(A) INTRODUCTION

The analytical foundation for this RIA resides in the prediction of air quality in the year 2007. Ozone concentrations are a function of meteorology, precursor emissions, and the air chemistry that transforms them into ozone. Air chemistry and meteorological considerations are exogenously determined, which leaves the inventory of precursor emissions as the only endogenous component of this analysis. The purpose of this chapter is to discuss the process through which the analytical team identified future VOC and NOx inventories as inputs to the air quality models that predicted air quality values on a county by county basis for the year 2007.

IV(B) METHODOLOGY FOR DETERMINING THE ANALYTICAL BASE CASE

"Base case" refers to the projected inventories of VOC and NOx control measures projected to exist in the United States in the analytical base year, 2007, [1] beginning with the 1990 interim emissions inventory. Economic growth works to increase the number of emissions sources over time, and that rate of increase varies between geographic regions, between SIC categories, and within SIC categories across regions. This section of the RIA discusses the process by which the staff projected the inventory of available VOC and NOx control measures to the analytical base year. Control measures, motor vehicle measures, and offsets discussed below in IV(B)(1), (2) and (3) are a distillation of the information documented in "Ozone NAAQS Review CAA Base Case Evaluation for 2007 - Draft Final Report" (hereinafter referred to as the "base case technical support document" or Pechan 1994c). The emissions and cost projections are based on two to four year-old data. In many cases, the projections have changed significantly since that time. The Agency plans to use updated estimations in future NAAQS analyses.

IV(B)(1) VOC EMISSIONS AND COST PROJECTIONS

The EPA projected emissions and costs for the control of VOCs by using the Emission Reduction and Cost Analysis Model for VOC (ERCAM-VOC) [2] in conjunction with the Interim 1990

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1 2007 was chosen because most of the mandatory CAAA requirements will have taken full effect and most areas currently in violation are expected to achieve attainment of the current NAAQS standard by this year.

2 The Emission Reduction and Cost Analysis Model (ERCAM) was initially developed by E.H. Pechan and Associates, Inc. under contract to the EPA, for examining the cost and emission impacts of alternative strategies for reducing NOx and VOC emissions. The model covers all sectors of ozone season VOC and NOx emitters including stationary point sources, area sources, and mobile sources.

Inventory.[3] CAA provisions in titles I, II, and III affect VOC emissions. Table 4-1 shows a summary of VOC emission reductions and costs by title for projection year 2007.

IV(B)(1)(a) TITLE I VOC REDUCTIONS

Consumer and Producer Products: The 1990 CAA Amendments direct EPA to complete a study of significant VOC emitting products and regulate to Best Achievable Control levels categories of consumer or commercial products that account for at least 80 percent of VOC emissions in four prioritized groups. This analysis assumes a 50 percent VOC emission reduction after all four groups have been regulated, rule effectiveness of 80 percent, and a cost effectiveness of $2,000 per ton of VOC reduction. This measure is applied to control VOC emissions from personal products, household products, automotive products, and commercial adhesives.

AIM Coatings: In anticipation of a rulemaking, this analysis estimated 45 percent control by 2002,[4] an 80 percent rule effectiveness, and a cost effectiveness of $2,000 per ton, applied to emissions from architectural surface coatings, industrial maintenance coatings, and traffic paints.

Stage II Vapor Recovery: Title I of the CAA requires Stage II (at the nozzle) vapor recovery systems for gasoline dispensing stations in ozone nonattainment areas which have a designation of serious, severe or extreme. In addition, this analysis models Stage II vapor recovery across the entire Northeast ozone transport region (OTR) to capture the impact of the stage II comparability provision of the 1990 Amendments, which requires the OTR to adopt stage II or measures achieving comparable reductions. This analysis assumes Stage II to be fully implemented in 1996, assuming size cutoffs of 10,000 gallons of gasoline per month (50,000 gallons for independent small business marketers). The Act prescribes a control device efficiency of 95 percent. Annual inspections are assumed to bring the overall VOC reduction from Stage II vapor recovery to 86 percent at a cost of $908 per ton. Stage II vapor recovery reductions are measured prior to onboard vapor recovery reductions (i.e., from an uncontrolled baseline).

Reasonably Available Control Technology (RACT): Ozone nonattainment areas and the OTR must install RACT on all major stationary sources. The definition of major source varies according to the nonattainment severity as follows: moderate or marginal, 100 tpy; serious, 50 tpy; severe, 25 tpy; extreme, 10 tpy; and for the OTR, 50 tpy. Point and area source RACT controls are described in the base case technical support document. This analysis assumes that all point source emitters are above the major source size definition. Some Title III MACT overlaps with RACT

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3 The Interim 1990 Inventory is not connected to AIRS. It was developed for EPA by E.H. Pechan and Associates for use in the base case technical support document. For more information, see EPA-454/R-93-021a, May 1993: "Regional Interim Emission Inventories (1987-1991), Volume I - Development Methodologies".

4 Inventory estimates for this source category were established before the AIM coating rule was proposed. Subsequent information not included in this analysis indicates the level of reduction and the cost per ton discussed above are probably overstated.

requirements. In these cases, reductions and costs have been attributed to Title III to prevent underestimation of emission reductions and costs attributed to RACT. The impact of VOC RACT on sources less than 50 tpy is not adequately captured in this RIA because the 1990 Interim Inventory for stationary point sources inventories did not contain emissions for them.

New CTGs: To date, only the Synthetic Organic Chemical Manufacturing Industry (SOCMI) reactor/distillation CTG has been finalized. Shipbuilding and repair and aerospace CTGs parallel the MACT standards and are therefore included under Title III. Alternative control technique (ACT) guidelines were published in place of the remaining new CTG categories, including clean-up solvents, volatile organic liquid (VOL) storage tanks, batch processes, web offset lithography [5], plastic parts coating, autobody refinishing, and wood furniture coating [6]. The majority of these categories are included under Title III MACT as well.[7] In addition, there is overlap between the SOCMI HON and SOCMI reactor process rules with source reductions attributed to the HON rather than the new CTG. Costs and reductions for expected new CTGs can be found in the base case technical support document. The emission reductions for new CTGs in Table 4-1 includes those associated with SOCMI Reactor/Distillation, batch processes, and web offset lithography. Costs and reductions for the other categories are accounted for under Title III since there are MACT regulations expected in addition to the new CTGs.

Rate of Progress (ROP): The 1990 CAA Amendments (CAAA) require interim emission targets to be met in ozone nonattainment areas prior to an area's attainment deadline. Costs for measures that come on-line after 1996 will already be included within the cost for mandatory controls in 2007, so progress requirement costs should only reflect the cost of measures that an area would not otherwise implement. The 1990 Amendments further require serious, severe, and extreme nonattainment areas to achieve a 3 percent reduction per year until their attainment deadline. These post-1996 ROP requirements can be met by either VOC or NOx (or a combination) emission reductions (depending on the results of UAM modeling and targets chosen for attainment). The hierarchy for choosing ROP measures is:

1) New CTG categories that have been delayed or published as ACTs;
2) Title III controls scheduled for promulgation in 1997;
3) Stage II vapor recovery (if not already required);
4) Reformulated gasoline (if not already required); and
5) Enhanced I/M (if not already required).

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5 For this analysis, web offset lithography costs are zero, due to the availability of recovery credits.

6 The Agency issued a wood furniture CTG earlier in 1996, but it was not available in time for this analysis.

7 The costs and emission reductions for SOCMI reactor/distillation (EPA, 1991b), batch processes (EPA, 1991c), and web offset lithography (EPA, 1992a) are the only source categories included in this analysis as new CTGs.

The base case technical support document shows costs for measures not otherwise implemented by 2007 under CAA requirements. Based on these measures, the incremental reduction in 2007 due to 1996 ROP requirements is 503 tpd, with an incremental annual cost of $188 million.

Point Source VOC Offsets: Point source VOC offsets were modeled by projecting no growth in emissions after 1996 for moderate, serious, and severe ozone nonattainment areas and in the OTR. Offsets were measured as the growth that would occur between 1996 and 2007 without the growth constraint. The level of offsets needed is shown in Table 4-1. Once a nonattainment area is redesignated to attainment, new sources are subject to Prevention of Significant Deterioration provisions rather than NSR. This may decrease the amount of offsets required, particularly in less severe nonattainment areas that would be expected to redesignate earlier. Reductions to achieve offsets come from increasing control on existing sources, plant closures, or mobile source controls (such as vehicle scrappage programs). Plant closures are included within the decreases in activity predicted for certain industry categories already incorporated within the calculation of the required offsets. Measures needed to meet offsets must be accounted for after measures needed to meet 15 percent ROP requirements since these measures would already be in an area's SIP and could therefore not be used for offsets. [8]

Maintenance Plans: During the redesignation process, States must submit maintenance plans to EPA that show that future precursor emissions will not exceed those in the attainment inventory. Potential impacts of maintenance were analyzed by examining the emission projections for each nonattainment area through 2007. Since emissions continued to show a decline, no further controls were modeled to simulate maintenance plan requirements. Additional controls may be needed if the levels are not sufficient to reach attainment, but this is covered under the analysis of the current standard in Chapter V of this RIA as a residual base case ozone problem.

IV(B)(1)(b) TITLE II VOC REDUCTIONS

Spark Ignition Standards: Only Phase I costs are included in this analysis because cost data were not available for Phase II standards. The EPA estimates a 45 percent VOC reduction in 2007 for this source category at a cost of $213 per ton of reductions. The EPA established the cost effectiveness of this category as the net present value of the stream of costs between 1990 and 2007 divided by the net present value of the stream of emission reductions. Further clarification for this category can be found in Attachments A and B of the base case technical support document.

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8 The NSR emission offset program allows construction of a major new source which emits pollutants in excess of specified amounts and would contribute to an existing violation of a NAAQS only if that source obtains equivalent offsetting emission reductions (emission offsets) from existing sources. The CAAA increased the stringency of offset requirements in ozone nonattainment areas by decreasing the major source size threshold and increasing the offset ratio. The size threshold for triggering NSR depends on the classification of the ozone nonattainment area.

Recreational Marine Vessels: This analysis estimates overall per-engine VOC reductions will be 50 percent, with a starting year of 1998 and a 17-year life span for engines. Therefore, overall reductions in 2007 are estimated at 20 percent with expected fleet turnover at that time. Since no cost data are available, a generic value of $2,000 per ton is used to represent annual costs.

Onboard Vapor Recovery: The rule requires installation of onboard refueling vapor recovery (ORVR) systems beginning in model year 1998 for light-duty gasoline vehicles (LDGV), 2001 for light-duty gasoline trucks (LDGT) with Gross Vehicle Weight Rating (GVWR) of 6,000 lbs or less (LDGT1), and 2004 for remaining LDGTs (LDGT2). Vehicle refueling emissions are projected by multiplying forecasted gasoline consumption by MOBILE5a (EPA, 1994b) State adjusted emission factors (grams per gallon). Cost effectiveness values for this category came from the Onboard RIA and are based on the 1998 net present value of costs and reductions. The EPA estimates incremental per vehicle costs for onboard (including production costs, operating costs, and fuel economy benefits) at $5 per vehicle for all light duty vehicles (EPA, 1993a). This per vehicle cost was multiplied by the expected annual sales to determine the annual cost in 2007. Nationwide, cost effectiveness is estimated to be $142 per ton.

IV(B)(1)(c) TITLE III VOC REDUCTIONS (MACT)

MACT standards are expected to reduce VOC emissions because many Hazardous Air Pollutants (HAPS) are also VOCs. The base technical support document shows the MACT standards modeled and the associated reductions.[9] The percentage reductions are from baseline (rather than uncontrolled) levels. This analysis assumes that RACT is already part of the baseline for sources covered by MACT. Many nonattainment areas may already have standards equivalent to MACT as a result of ozone nonattainment related controls (e.g., RACT, CTGs, State Implementation Plan [SIP] measures). No attempt is made to distinguish whether these controls are also classified as RACT or SIP measures in the ozone nonattainment areas. Also, reductions in nonattainment areas may be overestimated if the SIP requirements are already as stringent as the MACT standards will be. As shown in Table 4-1, Title III MACT reductions are estimated to be almost 1.8 million tpy nationally and approximately 5.6 thousand tons per day. This analysis assumes rule effectiveness is 80 percent and rule penetration is 100 percent. Any penetration rates less than 100 percent were incorporated into the control technology efficiency parameter. [10]

IV(B)(1)(d) RCRA VOC REDUCTIONS

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9 Of the MACT controls in the technical support document, only halogenated solvent cleaners, coke ovens, and the hazardous organic national NESHAP (HON) are effective in 1996.

10 MACT reductions incorporate "rule penetration" when the MACT standards have provisions which exempt certain sources and an 80 percent rule effectiveness parameter not included in the MACT RIAs.

Hazardous Waste Treatment Storage and Disposal Facilities (TSDFs): Emissions from TSDFs are regulated through RCRA and will restrict emissions from tanks, containers, and surface impoundments as well as 90-day accumulation tanks at generators. The Agency expects the reduction to be approximately 94 percent, at a cost of $191 per ton and 80 percent rule effectiveness (STAAPA-ALAPCO, 1993).

TABLE 4-1
VOC EMISSION REDUCTIONS FOR PROJECTED YEAR 2007

Measure	**Reductions (thousands of tons)** Annual	Ozone Season *
Title I		
Consumer and Commercial Products	570	2.1
AIM Coatings	295	1.1
Stage II Vapor Recovery	149	0.4
RACT **	606	2.3
New CTGs **	64	0.2
Reasonable Further Progress		0.5
Title II		
Spark Ignition Standards	606	2.1
Recreational Marine Vessels	95	0.3
Onboard Vapor Recovery ***	277	0.8
Title III		
MACT **	1,795	5.6
RCRA		
Treatment Storage and Disposal Facilities (TSDFs)	1,741	4.8
Landfills ****	119	0.0
TOTAL	**6,317**	**20.2**

* Tons per day

** See Appendix A for a further discussion of each of these VOC categories.

*** The standard specifies a 3 year phase-in at 40 percent in the first model year, 80 percent in the second, and 100 percent thereafter.

**** 17% of consumer solvent emissions are believed to come from landfill disposal.

Landfills: The EPA expects reduced landfill emissions of 98 percent at a cost of $530 per ton with an 80 percent rule effectiveness. Emissions from landfills are not included in the area source inventory. The Agency assumes 17 percent of consumer solvent emissions come from landfill disposal (55 FR24468, 1991).

IV(B)(2) NOx EMISSIONS AND COST PROJECTIONS

NOx emissions and control costs were projected to 2007 for expected CAA controls using the ERCAM model for NOx (ERCAM-NOx). The model uses the Interim 1990 Inventory as the basis for projecting emissions and costs. 1990 utility emission estimates are based on EIA Form 767 fuel use data submitted by utilities. This comprised the set of existing units. New utility units were then added to this inventory and could be classified as planned [11] and generic [12] units. The methodology for estimating growth in emissions at existing utility units was based on process-level (SCC) capacity utilization changes to acknowledge utility units that are not fully utilized in 1990 may be used more extensively in the future. Projection year capacity factors were developed at the process level based on the average capacity utilization calculated for each unit from 1987 through 1991.[13] Utility units of all fuel types were assumed to retire after 65 years of service.

The analysis team used the set of utility NOx control equations listed in the ERCAM-NOx model documentation to calculate NOx emission reductions costs from electric utilities. This analysis assumes a rule effectiveness of 100 percent for utility units since continuous emission monitors are required. If this rate was within 10 percent of the required controlled emission rate, it was assumed that the controlled emission rate could be achieved by minor operational changes at no additional cost. Control measures were assigned to each utility unit based on the degree of operational change necessary for that unit to achieve its required emissions limit. A listing of these controls can be found in the technical support document (Pechan 1994c).

IV(B)(2)(a) TITLE I NOx REDUCTIONS

Utility RACT Controls: Rates for utility units required to apply RACT controls under Title I are specified in the NOx Supplement to the Title I General Preamble. These include emission rate limits for oil- and gas-fired boilers. New units sited in nonattainment areas or the OTR are subject to more stringent NSR emission limits. Emission rates are summarized in the technical document (Pechan 1994c) which encompasses controls specified by Title I, Title IV, and new source performance standard (NSPS) regulations. This RIA assumes any unit affected by Title I that was already at or

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11 A planned unit is one that did not exist in 1990 but was expected to come on-line in the future.

12 Generic units are 'placeholders" created in the utility data base to meet future generation needs not met by existing or planned units.

13 The process used for calculating these values is discussed in more detail in the ERCAM-NOx model documentation.

below the limit required for that type of unit continued emitting at that lower rate. RACT was applied to major sources in ozone nonattainment areas and the OTR. NSR provisions require lowest achievable emission rate (LAER) level controls for new or modified major stationary source in nonattainment areas and the OTR. Specific LAER requirements are not listed, but limits of 0.10 lb NOx/MMBtu for coal-fired boilers and 0.05 lb NOx/MMBtu for oil- or gas-fired boilers were determined for LAER.

Utility NOx Offsets: Nonattainment NSR requires NOx emissions from new units located in nonattainment areas or the OTR to be offset by emission reductions at other sources within the same nonattainment area. Emissions from existing units that retired between 1996 and 2007 were subtracted from the offset requirement. The remaining emissions from new units were offset at a 1-to-1 ratio by applying selective catalytic reduction (SCR) controls to existing units within the nonattainment area or rest-of-State area.

Units from which offsets would be obtained were selected by ordering the set of existing units in the given area by decreasing controlled 2007 emissions. An assumed NOx reduction of 80 percent from the application of SCR was applied to each existing unit until the area's offset requirement was met. The final offset in a given area was taken from the unit with the lowest emissions that could still provide the necessary reduction. If a nonattainment area did not have sufficient existing utility emissions to offset all new utility NOx emissions, the shortfall was taken from the closest nonattainment area to it.

Non-Utility RACT: Title I of the CAAA requires NO_x RACT [14] on major sources in nonattainment areas. In addition, NO_x RACT is required throughout the OTR. NO_x RACT controls are to be installed no later than May 21, 1995. In order to model the costs and reductions associated with this requirement, representative RACT levels were chosen for each source type. The fraction of emissions above the source size cutoff is equivalent to the penetration rate for a fuel combustion area source category. The controls developed for point source industrial boilers were utilized for area sources with the average cost per ton values used to estimate total annual cost. NSR requirements include provisions for applying LAER to new major sources. This was modeled as a 95 percent efficiency with a rule effectiveness of 100 percent to simulate the enhanced monitoring program for all NSR units and top down BACT and LAER constraints. Costs for LAER were not estimated in this analysis. The costs associated with the offset provisions of NSR for non-utility point source emitters include the cost of applying more stringent control to existing units to achieve the necessary offsets.

Non-Utility NOx Offsets: Non-utility point source offsets were modeled by assuming no point source emission growth occurs after 1996 in moderate, serious, severe, and extreme ozone nonattainment areas and the OTR. The amount of offsets required was then estimated as the new source growth between 1996 and the model year. Any negative growth that occurs was considered a decrease in source activity. While existing source emitters are potentially subject to the NO_x RACT requirements for ozone nonattainment and ozone transport areas, new major sources were subject to NSR requirements. Any positive growth which occurred after 1996 from existing non-utility point sources within the OTR or an ozone nonattainment area of moderate, serious, severe, or extreme

14 EPA has defined RACT as the lowest emission limitation that a particular source can meet by the application of a control technology that is reasonably available, given technological and economic feasibility. RACT control levels are specified individually by each State.

classification was subject to the NSR provisions, including provisions for applying LAER to new major sources, which was modeled as a 95 percent efficiency with a rule effectiveness of 100 percent. These assumptions were used to simulate the enhanced monitoring program required for all NSR units and top-down BACT and LAER constraints.

Maintenance Plans: During the redesignation process, States must submit maintenance plans to EPA that show that future precursor emissions will not exceed those in the attainment inventory. Whether an area will need to implement controls equivalent to the reductions achieved through this area source cap depends on the trend in emissions from the remaining source categories. If the area continues to show declines in motor vehicle and nonroad emissions (due to control measures which increase in effectiveness over time) or stationary source emissions (due to new MACT initiatives) sufficient to offset any growth in stationary source emissions, then the area source cap is not needed to demonstrate maintenance.

Table 4-2 shows the NOx reductions resulting from this cap. These reductions are measured as the difference in 2007 area source emissions with and without this constraint. Since these caps begin in the attainment year for each area, overall reductions will be highest for moderate areas (with an attainment deadline of 1996) and zero for severe-17 and extreme areas, which are not required to attain until 2007 or 2010.

TABLE 4-2
NOx EMISSION REDUCTIONS FOR PROJECTED YEAR 2007

Measure		Reductions (thousands of tons) Annual	Ozone Season *
Title I			
	Utility RACT / LAER Controls	3,257	9.5
	Utility NOx Offsets	70	0.2
	Non-Utility RACT / LAER Controls	494	1.4
	Non-Utility NOx Offsets	9	0.0
	Basic I/M	5	0.0
	Enhanced I/M	440	1.3
Title II			
	Reformulated Gasoline	53	0.0
	California Reformulated Gasoline	33	0.1
	California LEV Standards	124	0.4
	Compression Ignition	498	1.7
	Spark Ignition	(23)	-0.1
	Marine Vessels	(2)	0.0
Title IV			
	Control Development Technology	3,338	9.7
TOTAL		**8,296**	**24.2**

* tons per day

Basic I/M Programs: The EPA established performance standards and other requirements for basic and enhanced I/M programs on November 5, 1992, requiring enhanced I/M programs in serious, severe, or extreme ozone nonattainment areas with urbanized populations of 200,000 or more; CO nonattainment areas with a 12.7 ppm or higher design value and an urbanized area population of 200,000 or more; and all metropolitan statistical areas with a population of 100,000 or more in the Northeast OTR.

Costs for basic I/M are based on the regulatory analysis for enhanced I/M. EPA estimates total per vehicle cost, based on the inspection fee, average repair cost, and the fuel economy benefit, at $5.70, which was applied to LDGVs, LDGT1s, and LDGT2s where basic I/M is chosen as a control. If basic I/M was selected for projections and the county already has a current I/M program, then no additional cost was attributed to that area.

Enhanced I/M Programs: The Agency estimated the per vehicle cost for enhanced I/M to be $6.70, based on a test fee of $9 ($18 per test and a biennial program), an average repair cost of $14.20 per vehicle, and an average fuel economy benefit of $16.50 per vehicle. In the typical ozone nonattainment area, adopting an enhanced I/M program reduces passenger car emitted NOx by 10 to 11 percent *vis a vis* a base case that includes basic I/M programs. Factors that affect area-to-area variations in these values include ambient temperatures, fuel characteristics, and travel speeds. While primarily a NOx management tool, some VOC emission reductions result from the application of enhanced inspection and maintenance measures. The Agency expects these VOC reductions to cost $500 per ton reduced. Associated NO_x emission reductions are $1,850 per ton. Annual costs are estimated by applying the per vehicle costs to the projected vehicle registrations for an area.

IV(B)(2)(b) TITLE II VOC AND NOx REDUCTIONS

The EPA expects evaporative VOC emissions to be reduced in future gasoline-powered cars as new Federal (and California) evaporative test procedures are applied. EPA expects the initial retail price equivalent increase of about $10 per vehicle to be largely offset by fuel savings (EPA, 1993b). Therefore, the net cost to the consumer is estimated to be $1 for light-duty vehicles (LDVs), $8 for light-duty trucks (LDTs), and -$13 for heavy-duty vehicles (HDVs). Emission reductions resulting from the improved evaporative test procedure are estimated using MOBILE5a. EPA estimates a weighted average cost effectiveness figure of $500 per metric ton (VOC) or $454 per short ton. Annual costs are estimated using the net vehicle cost and the estimated sales in the projection year.

Motor vehicle emissions contribute almost 30 percent of 1990 anthropogenic VOC emissions and 32 percent of NOx emissions (Pechan, Sept. 1994). Therefore, the 1990 Clean Air Act Amendments targeted motor vehicles for further control of both VOC and NOx. Motor vehicle related controls result from Title I ozone and CO-related nonattainment provisions as well as Title II, which specifically addresses mobile sources. This section summarizes the emission reductions and costs of these motor vehicle measures. Motor vehicle projections were based on ERCAM-VOC and ERCAM-NOx. Base year VMT was projected to future years based on national VMT projections from the MOBILE4 Fuel Consumption Model, scaled to metropolitan areas based on population projections and adjusted to ozone season daily values using temporal allocation factors. Ozone nonattainment area-specific emission factors were then applied (by vehicle type and roadway classification) to project future year ozone season daily emissions. Annual emissions were projected by allocating VMT to a monthly basis and applying State-specific MOBILE5a [15] emission factors based on the monthly temperature and RVP data. Control options are specified at the county level. VOC and NOx motor vehicle control measures are documented in the base case technical support document.

Tier I Emission Standards: The emission benefits of the Federal Tier 1[16] emission standards in Title II of the CAAA were estimated using the emission factor equations from MOBILE5a. Each model year vehicle (or group of model years) has a corresponding emission factor equation. The differences between estimated Tier 0 (pre-CAA vehicles) and Tier 1 vehicle emission rates over the expected vehicle lifetime were compared with net present value control costs to estimate the cost effectiveness of an emission standard. Tier 0 and Tier 1 LDGV emission factor equations for VOC and NOx are listed in the base case technical support document. EPA estimates the cost of Federal Tier 1 emission standards will be about $3,700 per ton for VOC control. This value was estimated using the same $36.75 per vehicle cost figure as above, but the emission factor equations changed with MOBILE5.

Reformulated Gasoline: EPA estimated the cost of Phase I reformulated gasoline to be about 4.3 cents per gallon in the summer. Since there is no RVP control in the winter, the wintertime cost of reformulated gasoline is slightly less than the summertime cost, or approximately 4.2 cents per gallon. Wintertime reformulated gasoline costs in oxygenated fuel areas are computed at 2.1 cents per gallon. The Agency estimated Phase II average costs to be 8.6 cents per gallon. (EPA, 1991a)[17]

California Reformulated Gasoline: California Phase 1 reformulated gasoline standards mandate limits on RVP, use of deposit control additives, and the elimination of leaded gasoline. Each of these directives results in higher per-gallon costs of fuels to consumers. The California Air Resources Board (CARB) estimates the consumer costs of each of these three proposals. The total cost of California Phase 1 reformulated gasoline is estimated to be no greater than 1.5 cents per gallon. This is based on summing the maximum cost for RVP incurred annually (0.6 cents per gallon), the maximum cost for the typical range of deposit control additives (0.5 cents), and the maximum cost for lead elimination (0.4 cents). California has adopted regulations for Phase 2 reformulated gasoline. Phase 2 costs are significantly higher than those for Phase 1 regulations and represent an attempt to generate maximum reductions in criteria and toxic pollutants, and in the mass and reactivity of emissions from gasoline fueled vehicles. Phase 2 gasoline must meet specified standards for sulfur, benzene, aromatic hydrocarbons, olefin, RVP, oxygen, 90 percent distillation temperature (T90), and 50 percent

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15 A complete discussion of mobile source modeling can be found in reference 'User's Guide to MOBILE5 (Mobile Source Emission Factor Model)", EPA-AA-AQAB-94-01, MAy 1994.

16 Tier 1 emission standards are: 0.25 g/mile for non-methane organic gases (NMOG), and 0.4 g/mile NO_x, 3.4 g/mile for CO.

17 Proposed VOC standards using $5,000 per ton VOC as a lower limit were estimated to cost 6.5 to 8.3 cents per gallon for 7.5 psi RVP fuel and 8.4 to 10.2 cents per gallon for 6.8 psi RVP fuel. Similar costs for proposed VOC standards using $10,000 per ton VOC as an upper limit are 7.7 to 10.1 cents and 9.6 to 12 cents per gallon, respectively.

distillation temperature (T50). Phase 2 standards apply in California beginning January 1, 1996. This analysis assumes that California Phase 2 reformulated gasoline will cost an additional 17 cents per gallon.

California LEV Standards: LEV was modeled for only California in the base case analysis. CARB established four new classes of light and medium-duty vehicles in 1990 with increasingly stringent emission levels: transitional low emission vehicle (TLEV), LEV, ultra-low emission vehicle (ULEV), and zero-emission vehicle (ZEV). CARB also established a decreasing fleet average standard for emissions of nonmethane organic gas (NMOG). Auto manufacturers can meet the fleet average NMOG standard using any combination of TLEVs, LEVs, ULEVs, and ZEVs they choose. However, CARB also included a ZEV requirement as part of the LEV regulations, which was modified in 1996 to provide for introduction of ZEVs into California by automobile manufacturers but removed specific sales requirements until 2003, where 2 percent of the vehicles produced for sale in California must be zero-emitting vehicles. This percentage increases to 5 percent in 2001, and to 10 percent in 2003. In 1994, the Ozone Transport Commission (OTC) voted to recommend that EPA mandate the California LEV program in the Northeast, and shortly thereafter presented a petition to EPA. OTR LEV was not included in the base case analysis performed by E.H. Pechan. It was, however, included for the thirty seven Easternmost United States in the form of the 49-state LEV program for the determination of baseline air quality for purposes of this RIA. Further discussion of California LEV can be found in the base case technical support document.

IV(B)(3) REGIONAL NOx MANAGEMENT

This RIA's baseline includes the following:

- **Full implementation of current Clean Air Act Amendments of 1990 Amendments.** A discussion of this assumption can be found in the previous section of chapter.
- **Current implementation techniques mandated under subpart (2) of the Act hold.** The analytical team believes the most appropriate implementation strategy for this RIA would be the strict application of subpart (2) requirements, leaving any future flexibility to the analysis performed for the part 51 implementation strategies.
- **Implementation of a regional NOx strategy in the East which approximates the efforts of current regional efforts by OTC and OTAG.** Current efforts to address long range NOx transport issues include the OTR and efforts to expand the OTR requirements to the thirty seven Eastern United States. While these efforts are not complete, the staff anticipates their implementation far in advance of the 2007 air quality assessment undertaken for this RIA. The staff believes that these efforts will be in place in the year 2007, and because they are being undertaken to attain the current ozone NAAQS, they should be included in the analytical baseline of this RIA.

Current regional modeling efforts affect this RIA's baseline air quality by: (a) significantly reducing the affect of long range NOx transport in the East, (b) reducing the number of nonattainment areas under each alternative and the targeted reductions necessary within those that remain, and (c) reducing the number of residual nonattainment areas under each alternative. For purposes of identification, this baseline will be referred to in this RIA as the "Regional Control Scenario" (RCS). However, while these regional analyses are under way at this time, the strategies they represent are not in place. While the analytical team for this RIA believes these measures (or other measures with similar effects) represent a truer picture of the anticipated 2007 air quality, there is still a chance these regional efforts will not come to pass. Therefore, this second baseline, referred to in this RIA as the "Local Control Scenario" (LCS), provides an upper bound to the anticipated costs of the new ozone NAAQS in the event regional efforts fail to arise before 2007. LCS results appear at the end of this chapter, behind those of the analytical baseline (RCS). The only difference between the RCS baseline and the LCS is that under the regional control strategy, a 0.15# per million BTU NOx cap and a California LEV program are applied to each county in the ROM domain prior to the identification of areas where local ozone controls are still needed. [18]

IV(C) THE METHODOLOGY FOR DETERMINING OZONE CONCENTRATIONS IN 2007

"Baseline" refers to the set of hourly predicted ozone concentration values for each county in the contiguous United States predicted for the year 2007, prior to the imposition of any controls that may be needed to fully attain a NAAQS within a given nonattainment area. The baseline ozone concentration includes all regional control measures applied to meet the current standard. This section discusses the process we employed to create the analytical baseline, as well as a second baseline for the LCS. The staff used these baselines to identify eight sets of nonattainment areas, one each for the four alternative standards which were analyzed directly under the Regional Control Scenario (RCS) and the Local Control Scenario (LCS).

Monitored ozone concentrations greater than the standard are a necessary condition for an area to be considered nonattainment. Consequently, an argument can be made that any future violation of an ozone NAAQS should be based upon the presence of a monitor to record it. The number of counties with ozone concentrations that exceed the standard is probably greater than the number of counties for which such exceedances have been monitored. Therefore, examining only those counties which contain ozone monitors would understate the true nature of the ozone problem and the cost of its correction. In

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18 Statistical inference describes the population but does not address the specific characteristics of the individual observations within it. Consequently, the reader should keep in mind that the analyses performed within this RIA do not identify actual nonattainment areas in the analytical year. Instead, the identified counties which exceed any given standard and the nonattainment areas which come from them should be viewed as representative of the expected scope of each alternative's nonattainment problem. Given the limitations of the analyses presented in this and other chapters, the technical staff for this RIA believes that, on average, the predictions made herein are reasonable. For any given area, the models employed can over or under predict the true level of any estimation.

addition, ozone precursors and ozone itself can travel long distances. Consequently, transport is an important consideration for this analysis. For these reasons, the technical staff determined that, to fully model the impact of each alternative ozone standard in the year 2007, it would need to model ozone in every county of the contiguous United States for every hour of the analytical year. Ideally, we would have used an emissions inventory based model, but the Regional Oxidant Model (ROM)[19], the most sophisticated ozone model available at the time of this analysis, models only the Eastern United States for a ninety day period during the ozone season.

Other models have been employed for other areas, specifically the Southern Coast of California, but for the remainder of the country (part or all of the seventeen Westernmost States,) no ozone models existed. Staff investigated using a "patchwork" approach to ozone modeling through which ROM would be used to model the Eastern United States, South Coast modeling efforts would be used for the Los Angeles area, and a third model would be developed to predict ozone concentrations in the Non-Rom-Non-California (NRNC) remainder. Staff decided such an approach had significant methodological problems, primarily with respect to aggregation and comparison. While each model would provide estimations of the ozone concentrations in 2007, there was no guarantee that the predictions would be comparable. An ozone concentration in one area may or may not be equivalent to the same modeled value for another area, if the two values were derived by different models. Even if the problems associated with a patchwork approach could be resolved, these models still would not have addressed the need for modeling an entire year. This problem was most significant for the health benefits analysis, where outcomes are more directly linked to the ozone concentration.

Consequently, the Agency's analysts decided to apply a single modeling methodology across the entire contiguous United States and use this approach to approximate the expected ozone concentrations through out the analytical year. Although the model that was chosen has limitations, the analysts believes that the benefits of having a single comprehensive national model exceeded these limitations. Based on an analytical foundation of existing monitored data and ROM predictions for the Eastern United States, we developed an extrapolation technique (hereinafter called "Centroid") which allowed us to estimate ozone concentrations in every county in the United States in the year 2007. A more complete discussion of the Centroid methodology can be found below, and a complete discussion of the Centroid methodology can be found in the docket (Mathtech, 1996).

IV(C)(1) THE CENTROID METHODOLOGY

The Centroid methodology was based upon three existing data sets: the Aerometric Information Retrieval System (AIRS) Air Quality Subsystem (AQS) recorded values of actual ozone concentrations for 1990, and two ROM model runs for air quality. There are 890 monitor records in the 1990 AIRS database, many of which are in the Western United States, outside the ROM domain. The record for each monitor included the monitor identifier and 8760 hourly ozone concentration values, one

19 A discussion of the ROM model can be found in the docket in the documents listed at the end of this chapter.

observation for each hour in the analytical year. ROM predictions for 1990 were based upon the 1990 AIRS inventory and 1987 meteorology for the ozone season, with hourly observations predicted for each ROM gridpoint. For each ROM gridpoint, the ROM predictions for hourly ozone concentrations in 2007 were based upon the expected air inventories described above in IV(B), above (plus any adjustments to the inventory necessary to approximate the effects of regional control measures under the RCS).

The objective of the Centroid methodology was to compare the ROM predicted ozone concentrations in 1990 and those for our analytical baseline in 2007 to calculate a metric which could be applied universally to 1990 monitored values to transform them into a prediction of 2007 monitored values across the contiguous Untied States and throughout the analytical year. To do this, the analysts regressed ROM 1990 predicted values against ROM predicted 2007 values and then applied the coefficients from this regression to the hourly observations in 1990 to predict the average expected change in ozone concentration for those monitors. Once these data were transformed into hourly predicted ozone concentrations at monitor sites, these hourly predictions were interpolated to the geographic centroid of each county in the forty eight contiguous United States. The regression and interpolation processes are described below, in the remainder of this section.

IV(C)(2) ADJUSTMENTS TO MONITORED DATA

Most of the monitor records in the "AMP350" report of the AQS subsystem of AIRS had data missing for some hours during the year. For example, many monitor records have the midnight hour missing. In addition, many locations have a well defined ozone season and monitors often operate only during this season. No data are available outside of the ozone season for these monitors. Finally, some monitors occasionally fail to report hourly data, causing problems in determining 8-hour averages. The staff also discovered that more than one set of data were sometimes reported from the same site location. Therefore, the EPA developed a set of criteria and data assumptions to provide a defensible foundation for compliance analysis based on these monitor data:

Collocated Monitors: Each record had to correspond to a unique monitor. However, upon examination, it was discovered that seven monitoring sites had two sets of records. The EPA selected the maximum of the hourly values across the two collocated records.

Data Obsolescence: The analysts compared a list of the latest available 1990 monitor identifiers used for compliance purposes against the monitor identifiers in the AIRS database. The AIRS data had eleven monitors that did not exist in the EPA compliance list. These monitors were dropped from the current list of 1990 compliance monitors because the reported data was considered not suitable. Six monitors appeared on the compliance list that did not exist in the AIRS data. Of these six monitors, two were outside the continental United States. The remaining four monitors were late entries from NAPAP and were discarded for the present analysis. After adjusting for missing and dropped monitor records, 879 monitors remained.

Ozone Season Adjustments: Most monitors are not operated for 24 hours a day, 365 days per year. In fact a significant number of monitors are operated only during the ozone season. EPA reviewed the definitions of ozone seasons, and, with the exception of Indiana, Michigan and Texas, the ozone season used in the present analysis is the same as the ozone season used by staff and its contractors. Indiana and Michigan now have ozone seasons which end a month earlier than the definitions in place in 1988. The shorter Indiana and Michigan ozone seasons were adopted to be consistent with the present definition. Texas has ozone seasons which vary across the state from 8 months to the entire year. The ozone season used for Texas in this analysis was the entire year.

Selection Criteria: In previous analyses, the analysts excluded any monitor without data for the major portion of a year. To identify modeled nonattainment areas, any monitor having 90 days' worth of values during the ozone season was included in the analysis, as long as it reported at least eighteen hours for each day.

Missing Values: In previous ozone benefits analyses, missing monitor hours were filled-in using the mean of the concentration values for that monitor and hour of the day over the month which contained the missing value. However, a mean value skews the 8-hour average concentration. Therefore, the staff employed a different "fill-in" methodology. Rather than substitute a mean concentration value for a missing hour, the actual concentration value registered at the nearest monitor was used as the fill-in value, subject to the following limitations: only the nearest 25 monitors would be considered, and no data was to be "imported"from a monitor more than 500 miles away from the monitor having a missing data hour.[20] If the two criteria could not be met, then the mean of the concentration values method was used for that monitor and hour of the day. After testing these assumptions and filling in for missing data, we observed the following characteristics:

- On average, it took twenty three monitors to completely specify data during the ozone season,
- The average distance from a monitor to the location of a monitor used to import missing data was 4.4 miles, and
- On average, the farthest monitor used for filling in missing data was 150 miles from the monitor with missing data.

IV(C)(3) THE REGRESSION

After completing the data set for each monitor through the processes described above, the next step was to use these data to predict the ozone concentration for each hour at each monitor site in the year 2007. To do this, the analysts used an Ordinary Least Squares (OLS) regression of 1990 ROM predicted concentrations and a number of additional explanatory variables against ROM predicted

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20 In the East, observations have a greater variance but sites are closer to each other, which mitigates the affects of greater variability on predicted results. In the West, where monitors are spread out and counties are larger, the affects are just the opposite. Western ozone concentrations tend to have a relatively low variance. Therefore the low variability in monitored values mitigates the affect of a wider distribution of sites on predicted results.

ozone concentrations in 2007. This regression allowed the staff to predict the average expected change in ozone concentrations between 1990 and 2007.

OLS regressions are defined as BLUE - the Best Linear Unbiased Estimator of the relationship between a dependent variable and its independent variable descriptors. "Best" refers to the OLS characteristic that no other linear predictor has a lower variance. Consequently, while the estimates derived through the OLS process have a built in error when compared to observed values, no other linear model will consistently produce a better estimate of actual values such that the error term has a lesser variance. "Unbiased" means the OLS estimator does not carry within it any systematic error. Error terms are normally distributed with an average value of zero. Therefore, while still an estimator, there is no better linear estimator which could be applied to this analysis. The remainder of this section discussed this regression.

Functional Form: One of the key limitations of the OLS regression is that it is a linear program used to predict the photochemistry of ozone creation which constitutes a highly non-linear system. The staff investigated including quadratic terms within the OLS model to mitigate this limitation. In sample regressions on subsets of the data, the analysts determined that although a quadratic term based upon 1990 ROM predicted air quality was statistically significant, the explanatory power of such a term was minimal. Sample regressions indicated the coefficient for such a term had a magnitude of approximately 10^{-4}, indicating that only for ozone concentrations in excess of 224 ppm did the coefficient make a difference in the predicted ozone concentration outside the range of measurement error. Observations with values equal to or greater than 224 occur only in the worst nonattainment areas, where the predictive power of the quadratic term would not be needed to identify nonattainment areas. In addition, sample regressions performed without a quadratic term had coefficients of regression (R^2) above 0.90. Consequently, regressions run with a quadratic term contributed little to the overall explanatory power of the pure linear functional form. Therefore, this analysis rejected the inclusion of a quadratic term and applied OLS techniques on only linear terms.

Sample Selection: Data from the 1990 and 2007 ROM hourly predicted grid cell ozone concentrations were arrayed side by side into a set of over thirty million entries, such that each 1990 observation matched its 2007 counterpart in grid cell location, time of day, and date of observation. From this array, we applied a random number generator (LOTUS's @RAND function) to identify three random sets of numbers, the first for the x coordinate of the ROM grid cell, the second for the y coordinate of the ROM grid cell, and the third for the hour of observation. This set of coordinates, (x, y, t) formed the basis upon which the OLS regression could be performed. Geographically, ROM contains grid cells over water (primarily the Atlantic, the Gulf of Mexico, and the Great Lakes) and in Canada. Agency analysts culled the sample to remove these extraneous data elements.

The analysis team considered selecting its sample from a subset of the data such that the peak ozone concentrations were better represented in the regression. However, the data set from which the sample was selected had its own inherent bias toward higher ozone levels. Because the ROM data set covers the ninety day ozone season, one would expect ROM predicted ozone concentrations to be higher than actual values selected from outside the ozone season. Consequently, without further restricting the data set from which samples were drawn, the regression emphasizes higher values by virtue of exclusion. Together with the actual data available for monitored sites in 1990, the RIA analysts believes the OLS regression is sufficient to characterize the ozone problem.

TABLE IV-1
REGRESSION EQUATION STATISTICS
(Ordinary Least Squares)

INDEPENDENT VARIABLES	REGIONAL CONTROL STRATEGY (7,484 Observations)		LOCAL CONTROL STRATEGY (1,093 Observations)	
	COEFFICIENT	T-STATISTIC	COEFFICIENT	T-STATISTIC
Constant	9.4709	6.362	-1.09765	-0.403
ROM90	0.78766	292.809	0.904335	193.696 *
MFGPC	0.37046	0.506	1.66716	1.306 **
POP07	-2.3576	-2.487	2.47670	1.404 **
SEVR	0.88009	2.941	0.601086	1.255
SERS7	0.39421	1.247	-0.789582	-1.580 **
MAMD	1.3104	7.088	0.258379	0.748
Adjusted R^2		**.92**		**.973**

* Statistically significant at the one percent level
** Statistically significant at the twenty percent level

Model specification: To specify the relationship between 1990 and 2007 ozone concentrations, this regression includes five additional descriptive variables: MFGPC, POP07, SEVR, SERS, and MAMD. MFGPC is the growth rate in manufacturing earnings per capita between 1990 and 2007, determined through Bureau of Economic Analysis (BEA, 1990) data for the appropriate county. POP07 is the population growth rate for the county, also determined by data from the Census. SEVR, SERS, and MAMD are three binary variables which record the subpart (2) nonattainment classification associated with the 1990 ozone concentration for each county. Each variable records a one if the area would be classified severe, serious, or moderate and marginal respectively. If not, the variable records a zero.[21]

In sample runs, the regression revealed the five additional explanatory variables had little significance and, in several cases, contradicted the *a priori* expectations of the staff's experts. The analysts believe the insignificance of these variables arises from the fact that the ROM model already accommodates these characteristics; but because the regressions will be used to extrapolate air quality beyond the ROM domain, the five additional descriptive variables must be retained to account for differences in air quality, especially in non-ROM counties. The results of the two regressions are listed below in Table IV-1. A more detailed discussion of the regression can be found in the docket (MathTech, 1996).

21 For an area in attainment, all three variables would record a zero. Therefore, each dummy variable can be interpreted as the marginal change in ozone concentration that can be expected to occur between 1990 and 2007 due to the severity of the area's ozone problem, relative to an area's meeting the standard.

Results: The OLS regression resulted in a coefficient of approximately 0.79 for the 1990 ROM-predicted ozone concentrations. Because the coefficient for ROM90 is less than unity, given the full implementation of the Clean Air Act Amendments of 1990 and the application of a regional NOx program in the East, one can expect ozone concentrations to decline between now and 2007, everything else held constant.[22] In other words, ROM predicts that for the ROM domain, on average, the rate of decrease in ozone concentrations due to the imposition of 1990 CAAA requirements will be greater than the rate of increase in ozone concentrations due to economic growth for that same area. This general conclusion also holds for the local control scenario sensitivity analysis, reported in the rightmost two columns of Table IV-1.

The independent variables for growth rate and nonattainment area designation explain additional variation modeled by ROM between 1990 and 2007. *A priori*, it is expected that, everything else held constant, areas with higher growth rates should experience increases in ozone concentrations between 1990 and 2007. These expectations are sensitive, however, to the inherent nonlinearities of the ROM model and the particular control strategies being modeled by ROM. Both these factors contribute to the differences observed in Table IV-1 between the regression results for the two baselines.

Application: Under the assumption that the estimated relationship found in the ROM domain would hold in the Western United States, the results of the regression analysis were applied to each monitor by multiplying each hourly monitored value by the appropriate scalar coefficients. These adjusted hourly values constituted a nation-wide prediction of monitored ozone concentrations in the year 2007. From the projected monitor values, the analytical team interpolated ozone concentrations to the geographic centroid of each county through a process described in the next section of this chapter. This interpolation does not lose any of the data richness found in the original monitored values. Instead, applying the OLS results to each observed value resulted in a linear transformation of that value to a 2007 predicted ozone concentration. Because the transformation was linear and based upon actual monitored values, the transformation kept the relative magnitudes of each observation.

IV(C)(4) INTERPOLATION TO CENTROID "PROXY" MONITORS

Based on the fill-in methodology described above, the Centroid methodology establishes a complete hour-by-hour stream of observations for each ozone monitor in the country. From the OLS regression described above, the staff used those monitored values to predict monitored ozone concentrations in the analytical year 2007. To completely specify the air quality in the contiguous United States, this RIA applies the Centroid methodology to create a "proxy" monitor at the geographic centroid of each county. For each county centroid "proxy" monitor, hourly ozone concentrations were assigned as if an actual monitor had been in operation at that location. The following methodology was employed to establish the hourly values associated with each "proxy" monitor.

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22 From a partial derivative standpoint, this is true, but because of the constant term, this is not always the case. For some low levels of ozone, the 2007 value can actually be overwhelmed by the magnitude of the other statistics. However, these levels were much too low to affect any of this RIA's conclusions.

For each county centroid, the RIA analysts identified the three closest ozone monitors that formed a triangle around it, ignoring relative elevations and calculated the hourly ozone concentration at the county centroid "proxy" monitor according to the following formula:

$$C_{c,i} = \sum_{j=1}^{3} \frac{(D - d_j)}{D} C_{j,i}$$

$$\textit{where} \quad D = \sum_{j=1}^{3} = d_j$$

where $C_{c,i}$ represents the concentration at the centroid "proxy" monitor for the i^{th} hourly observation, $C_{j,i}$ represents the concentration at the j^{th} monitor for the i^{th} hourly observation, with 1, 2, and 3 representing the surrounding actual monitors from which the linear transformation was performed. D represents the sum of the distance between each of the three surrounding monitors (d_j) and the enclosed centroid "proxy" monitor. Because $C_{c,i}$ is the distance weighted average of the values associated with its three surrounding monitors, by construction, its value was bounded by the lowest and highest values of those three monitors.

Some county centroids (for example, along the U.S.-Mexican, the U.S.-Canadian border, and continental coasts) could not be interpolated by using three surrounding monitors. For some other monitors, the distance from the centroid to one of the three closest surrounding monitors was greater than five hundred miles. In these cases, the analytical staff defined an alternative weighting scheme where weights were defined which varied inversely with distance. In this weighting scheme, the three nearest monitors were used, [23] whether or not they enclosed the centroid. 277 counties in the contiguous United States required the alternative weighting scheme, but none of them affected the results of this analysis. Under this alternative weighting scheme, the centroid was either part of a larger network of monitors and did not carry the design value which triggered nonattainment, or the county was not part of a nonattainment area.

IV(C)(5) LIMITATIONS AND CAVEATS FOR USING THE CENTROID MODEL

Predicting concentration values in some future year involves a great deal of uncertainty. However, the values have been produced under a specific set of assumptions and within the confines of a model that, at the time of this analysis, represents best estimates of what the levels and patterns of

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23 This weighting scheme is similar to other kriging methods used for predicting ozone concentrations. See Lefohn, A.S., et als., "An Evaluation of the Kriging Method to Predict 7-h Seasonal Mean Ozone Concentrations for Estimating Crop Losses," JAPCA 37:595-602 (1987).

concentrations will be in 2007. The major assumptions that must be considered in applying the results of this analysis include:

- **County concentrations can be represented by interpolating values from surrounding monitors to the geographic centroid of the county.** Predicting ozone concentrations based upon a linear transformation of the concentrations at the three closest surrounding monitors must, by design, produce a predicted value bounded by the highest and lowest of the three observations. Therefore, ozone predictions in any given county may be over or under predicted at the geographic centroid. This was of special concern for counties without monitors, since the county's design value ozone concentration would be driven by centroid values. However, the technical staff who worked on this problem do not believe this is a major concern because, as explained earlier in this chapter, there is an indirect relationship between the density of monitors and the variation in observations across monitors which minimizes the limitations of this caveat. In the East, monitors more than in the West for any given hour. However, in the East, monitors are much denser, thereby diminishing the variation in centroid interpolations. In the West, the opposite hold: monitors are farther apart but have very low variation, which again reduces the variance at centroid locations.
- **There is a linear relationship between monitored values.** This may or may not hold true, depending on the centroid and its surrounding monitors. Again, this is probably more true in the East where sites are closer than in the West.
- **Modeled concentration values for 2007 also represent modeled concentration values for the other two years necessary for a three year averaging period.** The ozone primary standards analyzed in this RIA all deal with a three year averaging period. In all cases, either the number of exceedances or the monitored values themselves are averaged over three years. However, the analytical scope of this RIA was limited to a single years' observations and the analysts assumed a single year's data represented a three year stream of values. While this may appear to be less rigorous, the level of uncertainty in current modeling techniques limits the value of adding a second and third year to the analysis. While the staff recognizes the potential for differences based on the limitation of a single year's data, the direction and magnitude of that bias are (a) unknown, and (b) probably not very large so long as a year with "representative" meteorology has been chosen. Using the 0.08 ppm five expected exceedence form for purposes of illustration, five expected average exceedences over three years actually means that, in any given year, up to *sixteen* exceedances can be allowed, so long as the other two averaging years do not have any exceedances of their own. Therefore, the standard value for any given year could be any of the actual exceedences in that year between the first and the sixteenth highest daily concentration. However, the underlying assumption is that this RIA is modeling a *representative* year, and that, on average, the ozone concentrations observed for other years would be very similar. Consequently, the staff believes that the actual ozone concentration which would trigger nonattainment is probably limited to a much narrower range, probably between the fourth and eighth highest value for the modeled year. Empirically, monitored data supports this hypothesis. For example, analysis of the three year period from

1993 through 1995 at sites which had three years' worth of data, the ozone concentration which triggers nonattainment occurred 29 percent of the time in 1993, 28 percent of the time in 1994, and 43 percent of the time in 1995.

- **Meteorological conditions are the same in 2007, 1990, and 1987.** Ozone concentrations are a function of precursor inventories and meteorology, with the variance in meteorological data much greater than that for inventories. Therefore, air quality models reveal the greatest change when the model changes its meteorology. However, most modeling is performed with meteorology held constant, mainly because of the resource intensive nature of changing it. Using the same meteorology in each analytical year carries with it the underlying assumption that the year chosen will capture the full range of ozone characteristics for all but the most extreme ozone years. However, in the regressions run for use in interpolating to areas outside the ROM domain, constant meteorology has a distinct advantage. Because the regression assesses the effects of meteorology as constant between 1990 and 2007, it "falls out" of the analysis, leaving behind a clearer picture of the impact of changing inventories.

Along with the assumptions listed above, the Centroid methodology carries with it several additional caveats. These include:

- **Centroid is monitor driven and the results are limited by the network of monitors in existence in 1990**. This may be especially limiting in the Western United States where monitors are relatively sparse. Consequently, the model may under predict the true degree of nonattainment for any or all of the alternative standards. However, this is a limitation that exists for all of the air quality models that were available at the time of this analysis.
- **The Centroid algorithm cannot be applied in about 10 percent of the counties in the 48 contiguous United States.** Generally, these are counties which fall near international or coastal boundaries or where at least one of the nearest three monitors was more than five hundred miles away. However, as discussed above, this limitation did not affect the overall results of this analysis.
- **The present analysis extrapolates outside the ROM domain, under the assumption that ROM temporal relationships between 1990 and 2007 hold for the Western United States.** Various explanatory variables were included in the regression equation to control for possible spatial differences in data that help to explain variations in concentrations over time.

IV(C)(6) CONCLUSIONS

While the application of an air chemistry driven national model would have been the optimal means by which the technical staff would have made its impact determinations, no such model existed at the time of this RIA. The best available air chemistry model at the time of this analysis was the Regional Oxidant Model. However, this model could not meet the need for a national complete year analysis. Therefore, this RIA developed an alternative model for predicting air quality in the year 2007 which relied upon the predictive strength of the ROM model but allowed for temporal and spacial interpolation. While Centroid has several significant limitations, statistical analysis of it compared to ROM, 1990 modeling predictions, and with independent sources indicate Centroid is statistically similar to each of the benchmarks analyzed. Therefore, while Centroid is not a pollutant dispersion model, it was the only tool available, given the requirements of this analysis. Therefore, the technical staff believes the Centroid model is a reasonable analytical tool for establishing preliminary impacts.

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V. METHODOLOGIES FOR DETERMINING EMISSION REDUCTION TARGETS AND CONTROL STRATEGIES

V(A) INTRODUCTION

This RIA does not, nor did it intend to predict the actual ozone concentration that will occur in the analytical year. Given the limitations of the analyses presented in this and other chapters, the technical staff for this RIA believes that, on average, the predictions made herein are reasonable. Instead, the identified counties which exceed any given standard and the nonattainment areas which come from them should be viewed as representative of the expected scope of each alternative's nonattainment problem. However, for any given area, the models employed can over or under predict the true level of any estimation. Therefore, the counties and nonattainment areas identified within this RIA should be viewed as representative of the expected scope of each alternative's nonattainment problem, rather than as a declaration of future attainment status.

Once emission inventories had been estimated for the year 2007, the next step was to estimate air quality for the analytical year. This was done by extrapolating 1990 monitored air quality data to 2007, using the Regional Oxidant Model (ROM) estimates of air quality in the Eastern United States as a scaling factor. After predicting ozone concentrations in 2007 for the entire contiguous United States, the RIA team identified potential nonattainment counties and their related nonattainment areas according to the requirements of subpart (2), described below in section V(B). ROM modeling and Urban Airshed Model - IV (UAM-IV) estimates of targeted precursor reductions for the current standard were then used as an input into the establishment of VOC and NOx targets for all identified nonattainment areas. This process is described in section V(C). V(D) describes the process by which projected inventories were translated into control strategies, and V(E) discusses the residual nonattainment phenomenon.

V(B) IDENTIFYING NONATTAINMENT AREAS

V(B)(1) DETERMINATION OF NONATTAINMENT AREAS - COSTS

The Clean Air Act (CAA) in Sec 107(d)(4) states:

"If an ozone nonattainment area located within a metropolitan statistical area or consolidated metropolitan statistical area (as established by the Bureau of the Census) is classified under part D of this title as a Serious, Severe, or Extreme Area, the boundaries of such area are hereby revised (on the date 45 days after such classification) by operation of law to include the entire metropolitan statistical area or consolidated metropolitan statistical area."

The CAA further states:

> "The governor can undertake a study to evaluate whether the entire metropolitan statistical area or consolidated metropolitan statistical area should be included within the nonattainment area. Whenever a Governor finds and demonstrates to the satisfaction of the Administrator, and the Administrator concurs in such finding, that with respect to a portion of a metropolitan statistical area (MSA) or consolidated metropolitan statistical area (CMSA), sources in the portion do not contribute significantly to violation of the national ambient air quality standard, the Administrator shall approve the Governor's request to exclude such portion from the nonattainment area. In making such finding, the Governor and the Administrator shall consider factors such as population density, traffic congestion, commercial development, industrial development, meteorological conditions, and pollution transport."

These principles apply to all nonattainment areas. If the air quality of an area violates the ozone standard, or if sources in that area contribute to violations in a nearby area, the area must be designated nonattainment. The general presumption is to designate the entire CMSA or MSA (C/MSA) or county, which ever is larger. Adjacent counties to a C/MSA should be attached to the C/MSA. Monitors are placed in counties downwind of the urban areas and may be located in counties just outside the C/MSA. When these counties measure violations they should be attached to the C/MSA or counties which contribute to the violation.

The above process for defining nonattainment areas does not necessarily hold when actually applied to a given area surrounding a monitor deemed not in attainment of the current standard. Instead, the CAA methodology acts as a starting point for a politically and economically driven process of adjustment that operates to reduce the size of the nonattainment area. This process cannot be modeled. Therefore, the analytical staff decided that when identifying nonattainment areas in the year 2007 for each of the alternative standards under each baseline scenario, the strict letter of the Act should be followed without regard for any process that would work to change the size and shape of the nonattainment area. While this decision tends to overstate the size of nonattainment areas and, hence, the associated costs and benefits of attainment, the decision does not incorporate subjective assessments of what changes might occur in any given nonattainment area. A second source of potential over-estimation in this analysis occurs because of differences between county definitions and those of C/MSAs. In many cases, a C/MSA definition includes partial counties. This analysis, however, includes the entire county whenever this situation arises. Therefore, the analysis has a second tendency for a slight overprediciton of the costs and benefits associated with each alternative standard.

For each county that exceeded the standard for any of the alternative standards, the following area identification rules were applied:

- If the county was included in the definition of a C/MSA, the entire C/MSA was identified as nonattainment.
- No partial counties were included in a nonattainment area definition. For partial counties within C/MSAs, the entire county was included in the nonattainment area definition.

- If a county was identified as exceeding any standard and was not part of a C/MSA definition, but was contiguous or very close to a C/MSA area which had been identified as nonattainment, the nonattainment area "absorbed" that near-by county. [1]
- If a county was identified as exceeding one or more of the alternative standards and was not sufficiently close to an existing C/MSA, the nonattainment area was defined as that single county.
- When a group of contiguous counties each recorded a violation but those counties were not part of or near a nonattainment C/MSA, those individual counties were combined into a single nonattainment area.

V(B)(2) IDENTIFICATION OF MARGINAL NONATTAINMENT AREAS

The current implementation strategy under part 51 requires marginal nonattainment areas to perform six tasks (EPA, 1996a):

- Institute a New Source Review (NSR) program
- Develop an emissions inventory
- Develop emission statements
- Establish periodic inventories
- Institute RACT "fix-ups"
- Perform I/M corrections

The first four tasks listed above do not require the imposition of control measures. Instead, each task incurs only administrative costs. While administrative efforts do not result in direct reductions of pollution, the Agency has long recognized the ability of non-control pollution management efforts to indirectly produce air quality improvements, as noted in the RIA for the part 70 Operating Permits Rule (EPA, 1992). For instance, a source may discover upon developing a new emission inventory that a simple adjustment to its boiler temperature can result in more efficient combustion and lower NOx emissions. Generally, administrative costs for these items are small, given the relative magnitude of the command-and-control costs associated with VOC and NOx measures. For example, the 1996 ICR for the Operating Permits Rule lists the data collection burden to sources as about $45 million annually for the entire nation. The subset of ozone nonattainment areas which would incur these costs would make that cost much smaller. Consequently, administrative costs are not included in this RIA. Administrative

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1 The goal of identifying nonattainment areas was to minimize the number of NAs necessary to fully incorporate all identified counties. If, for example, a county was identified as nonattainment and it sat between two existing C/MSAs, the staff selected the closest C/MSA to define as nonattainment if: both areas were already identified as nonattainment. However, if one C/MSA had been identified as nonattainment and the other had not, the staff chose the nonattainment C/MSA, even if it was further from the original nonattainment county.

costs will be discussed in detail as part of the Paperwork Reduction Act requirements for the part 51 implementation part of this NAAQS process.

The last two tasks listed above, while they require the application of control measures, are designed to correct shortfalls in previously required controls with regard to I/M and RACT. However, when creating its baseline inventories, the methodology employed in this RIA did not allow for less than one hundred percent compliance for each requirement. Therefore, by construction, while RACT "fix-ups" and I/M corrections may exist for any given marginal nonattainment area, those measures do not appear in the available inventory of controls. Consequently, these two tasks carry with them zero control costs within this analysis.

This inventory limitation may result in an underestimation of measurable control costs but for several reasons, the staff believes the overall impact on costs is small. First, the CAA mandated controls are for rule effectiveness improvements on existing measures. Current Agency estimates put the average rate of rule effectiveness at over ninety-five percent (EPA, 1996e, forthcoming). Consequently, the marginal improvements from the CAA mandated improvements (and their subsequent costs) will probably be very low. Second, these controls are for improvements in marginal nonattainment areas identified in 2007. Many of these areas will have been marginal nonattainment areas for a number of years *prior* to 2007. During that time, they would have been working toward addressing rule effectiveness. Consequently, there may be little left to do within these control cost categories in 2007. This assumption will be reviewed and may be relaxed during the next stage of the analysis. [2]

Given the mandatory tasks listed above and the two assertions that (1) administrative efforts may result in marginal improvements of air quality and (2) mandatory control measures may exist and be employed in some marginal nonattainment areas even though this analysis cannot identify when this may occur, this RIA assumes the mandatory measures listed above are sufficient for marginal nonattainment areas to attain the standard. However, it is possible that additional control measures may be needed to achieve some air quality improvements in some marginal nonattainment areas. Although the costs associated with achieving the improvements are likely to be small relative to other costs presented in this RIA, to the extent that there are control costs associated with these areas, the costs presented in this analysis are understated.

Marginal nonattainment under the current standard ranges from .12 to .138 ppm, or 15% beyond the standard. To determine an analogous range of marginal nonattainment for the alternative eight hour standards, the Agency's analysts investigated three different approaches: (1) rolling back the upper end of the current marginal nonattainment range by the same percentage that would be applied to roll back the current standard to achieve a .08 ppm level (i.e., by a factor of .86), (2) applying a similar distribution to nonattainment classifications to that which was used for the current standard, and (3) increasing the level of the .08 ppm standard by the same amount that would achieve the upper bound of

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2 The Interim Implementation Procedure established by the Agency to address the transition between the current and proposed ozone NAAQS includes a requirement for a 3% RFP to address ozone concentrations above the standard. This requirement was not a part of the current CAA requirements and was not considered for this analysis. However, the Agency plans on investigating this RFP requirement in the future, if appropriate.

the current marginal nonattainment range (i.e., by a factor of .15). The first approach resulted in too many marginal nonattainment areas. Multiplying the .138 ppm upper bound by the .86 factor resulted in an upper bound for the eight hour standards of .117 ppm. Under this scenario most nonattainment areas under an eight hour standard would be able to qualify as "marginal". Investigation of the second approach indicated it was unnecessarily complex. As the form of the eight hour standard changes, so does the number of nonattainment areas and their distribution. The second approach would result in a slightly different upper bound for marginal nonattainment in all of the eight hour forms. Therefore, the staff applied the third approach and established the upper bound for an analogous marginal nonattainment classification under an eight hour averaging time at .092 ppm, or 115% of the standard.[3]

V(C) IDENTIFYING TARGETED REDUCTIONS

Once nonattainment areas were defined under each alternative standard, the Agency's technical staff determined VOC and NOx reduction targets for each area exhibiting modeled air quality worse than that found in a marginal nonattainment area. The technical staff relied primarily upon the expertise of its air quality modelers for their recommended VOC and NOx targets. The Agency's air modelers used a number of sources to determine VOC and NOx targets for the RIA team:

ROM modeling: While limited to only the Eastern United States, ROM modeled air quality was an integral component in understanding the dynamics of air chemistry *vis a vis* emissions inventories. Over the years the Agency has performed a series of ROM analyses (matrix runs and NAAQS simulations) designed to investigate the regional implications of localized control for across-the-board VOC, NOx, and VOC + NOx reductions. Generally, these sensitivity runs were performed for targeted reductions in ten percent increments, providing a fairly clear picture of the interrelationship between emissions and air quality in each area. Within the limitations of the ROM model, these sensitivity runs provided the Agency with a source of targeted VOC and NOx reductions to attain the current standard and the eight hour alternatives within the ROM domain.

UAM modeling: The Urban Airshed Model (UAM-IV or UAM-V) predicts air quality in specific metropolitan areas, [4] utilizing meteorological and emissions data. Because UAM domains are defined for areas that violate or are in danger of violating the current ozone standard, these domains were generally areas that were predicted to violate at least one of the proposed standards. Therefore, the technical team further clarified its VOC and NOx targets for each UAM area based upon

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3 This range is consistent with the analysis performed in the Staff Paper (c.f., pp. A-21 -22).

4 The size of the UAM modeling domain is fixed and does not necessarily correspond to the area of the MSA, CMSA or nonattainment area associated with that urban location.

discussions with UAM modelers at the State, Regional and National level, as well as the results of the 1995 3rd Urban Airshed Modeling Workshop (UAM, 1995). [5]

OTAG modeling: Separate from the efforts in many of the Easternmost United States, a number of OTAG modeling efforts have been undertaken to determine the necessary reductions to achieve the current standard with the application of broad regional programs as a first step. Much of this work has been done with the help of the Agency's modelers utilizing the ROM model but some additional work has been done with UAM-V as well. Information from these modeling runs was combined with that garnered from other modeling efforts to establish estimates of the required VOC and NOx reductions to achieve each alternative standard.

AIRS data: In addition to the modeling results listed above, each nonattainment area has an emissions inventory for VOCs and NOx which is maintained by the AIRS program in RTP. This database supplied specific data, including population, emissions inventory and source geographical information which was used to further characterize nonattainment areas for purposes of aggregating nonattainment areas by control strategies.

Other Data: The staff also relied on several other sources of air quality modeling, including the South Coast Air Quality Modeling District (SCAQMD) and modeling efforts undertaken by other ozone nonattainment areas.

The sets of nonattainment areas under the LCS scenario always included the complete set of predicted nonattainment areas under the corresponding RCS scenario. In addition, time constraints prevented a complete modeling analysis to establish RCS targets. Consequently, this RIA established targets for LCS standards and then adjusted that information to accommodate the beneficial effect of regional strategies. For the current standard, existing ROM and UAM modeling efforts drove this RIA's methodology for determining VOC and NOx emission reduction targets. For example, of the ten predicted nonattainment areas in 2007 with ozone concentrations greater than marginal under the LCS for the current standard, seven were part of the ROM domain and had targets established under ROM, UAM modeling, or both. For the three nonattainment areas outside the ROM modeling domain, the California South Coast FIP (EPA, 1990) and additional modeling information garnered from the South Coast Air Quality Management District provided sufficient detail for VOC or NOx targets to be developed. One draw-back of this approach was that ROM and UAM modeling do not always use the same meteorology, episodes, or analytical base years, all of which work to drive their analyses toward different conclusions.

Determining the appropriate level of reductions for the eight hour standards was somewhat more problematic. Outside of a few ROM analyses, very little eight hour modeling had ever been done, and most existing work did not include regional NOx controls in its baseline. Consequently, a series of new eight hour ROM runs were performed to identify local VOC and NOx strategies under the LCS for each of the three alternative NAAQS. For areas outside the ROM domain, the analysis relied upon

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5 The 3rd Urban Airshed Modeling Workshop was held on September 12 - 14 1995 in Arlington, VA. The individual reports, key topic presentations, materials and panel recommendations from that meeting were gathered in a notebook which was distributed in October.

advice from air quality modelers and air chemists to establish targets for each eight hour alternative standard. For identified nonattainment areas which had no ROM or UAM modeling, targets were assigned for these "new" areas that were similar to the targets in "similar" nonattainment areas which had been modeled, using geographic characteristics as a measure of similarity.

Without sensitivity runs to determine appropriate RCS targets, the Agency's analysts needed to define a metric which would approximate the change in targets necessary for each alternative NAAQS under the RCS. The staff determined improvements which occur in any nonattainment area come from three components: the effects of local controls, the effects of the local contribution of any controls applied to address regional strategies, and the beneficial transport effects from upwind areas controlling for regional and local strategies. The inventories developed for this RIA allowed the team to differentiate between the first two components, but regional transport could not be quantified. However, the regional strategies chosen for inclusion in the analytical baseline focussed on NOx controls while most of the identified nonattainment areas in this RIA use VOC controls. Under the RCS, four of the forty identified nonattainment areas for the most stringent alternative used NOx strategies. Under the other eight hour alternatives, only one area, Atlanta, used NOx strategies. Under the current standard, no identified nonattainment area was assigned NOx targets. Given that regional controls focussed on NOx controls and the benefits of ozone reductions occur primarily in VOC management areas, the staff approximated the average improvement in air quality by examining the ROM regressions used to in the Centroid methodology. As described in the previous chapter, the ROM-based regressions performed with and without regional strategies provided two sets of coefficients. Comparing the coefficients on the ROM90 terms from the LCS and RCS regressions provides an estimate of the average change in ozone concentrations one would expect from the application of a regional control strategy. The ratio of coefficients is:

$$\frac{ROM90_{RCS}}{ROM90_{LCS}} = \frac{.79}{.90} \approx .88$$

Therefore, holding everything else constant, one would expect that, on average, air quality would improve by approximately 12% in the ROM domain in 2007 due to the imposition of a regional control strategy.[6] After identifying appropriate targets for each of the alternative standards under the LCS, the analysis team applied the regional strategy adjustment factor to each target to identify appropriate reductions for the analytical baseline.

Would a different adjustment factor have been a better approximation of the air quality improvements found through the RCS? The staff performed a sensitivity analysis of this factor by

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6 The two regressions described in the previous chapter include a number of other explanatory variables. However, of these variables, only one was significant under each regression, and it displayed different signs for the two regressions. Because of the lack of significance, the technical team ignored these variables in establishing a regional strategy adjustment factor.

looking at the change in impacts expected to occur under a .94 adjustment factor (i.e., applying half of the 12% average improvement). Examining the most stringent scenario, the analysis revealed there would be no change in the cost analysis presented in this RIA due to a .94 adjustment factor. For residual nonattainment areas under a .88 adjustment factor, there would be no change in costs or economic impacts because they had already exhausted their inventory of identified controls. However, three areas which had been considered within the range of this analysis' uncertainty and potentially able to attain the standard would change to residual nonattainment areas, but since they had already exhausted all identified control measures, their costs did not change. The three areas identified as able to fully reach their targeted reductions would be considered attainment areas under a .94 factor. Therefore, this RIA assumes the .88 factor is a reasonable measure of the change in targeted reductions required under the RCS.

An analysis of administrative costs associated with the ozone NAAQS will be considered during the part 51 implementation process, including actions that need to be taken by marginal nonattainment areas for ozone. The Agency will also consider the issues of Federal conformity and impacts on military readiness during the part 51 implementation process, and attempt to provide cost estimates associated with Federal conformity. The Agency did not estimate the cost associated with every known control measure, however. Time and resource constraints, in conjunction with having limited data prevent the Agency from analyzing the potential impacts of the ozone and PM NAAQS on regional transportation emissions, implementation of TCM, and localized transportation related effects. At this time, it is not possible to estimate the impact that the NAAQS will have on transportation plans in identified nonattainment areas because uncertainties are associated with these estimates. For example, because mobile sources are not individually inventoried, the actual number of establishments affected by these control measures is unknown. Consequently, any cost analysis using these control measures on mobile sources is highly speculative. Control measures such as these currently not included in the ozone control strategy cost analysis will be considered during the part 51 implementation process.

Time and resource constraints, in conjunction with having limited data also prevented the Agency from analyzing the potential impacts of the ozone and PM NAAQS on sources that receive Federal funding and are located in identified nonattainment areas, This information is not contained in the estimate of control strategy costs for the Federal Government (SIC 971). For each nonattainment area, the Agency has estimated the cost of controlling stationary sources *only* to achieve the ozone and PM NAAQS. Although the level of detail in the data bases the Agency used for this RIA is not sufficient to identify the ownership status associated with these controlled sources, it is reasonable to believe that some of these sources are located on Federal facilities.

V(D) SELECTING INCREMENTAL CONTROL MEASURES

Chapter IV(B) of this RIA describes the control measures included in this analysis. In general, the staff considered only conventional controls in developing its control strategies. Examples of conventional controls include reformulated fuels, enhanced I/M, and metal product surface coatings. In addition to these conventional controls, a number of less common controls were available for this analysis which had sufficient engineering and economic data to be included as well. Examples of these "extraordinary" controls include "layering" controls on combustion sources (e.g., LNB + FGR) and add-on controls for paper surface coating.

In some cases, the staff determined a specific control measure was not able to be included in this analysis. Typically, this decision was made based upon the lack of available data to fully characterize the cost effectiveness of the measure, or time and resource constraints prevented the Agency from assessing the potential impacts of the ozone NAAQS. In particular, the staff did not assess regional transport emissions, implementation of TCM, and localized transportation effects. At this time it is not possible to estimate the impact that the NAAQs will have on transportation plans in identified nonattainment areas because uncertainties are associated with these estimates. For example, because mobile sources are not individually inventoried, the actual number of establishments affected by those control measures is unknown. Consequently, any cost analysis using these control measures on mobile sources is highly speculative. These excluded controls are identified below. For each nonattainment area identified, the team created an inventory of anticipated control measures for VOC and NOx reductions in accordance with the methodology laid out in IV(B) and in the technical support document (Pechan 1994 a, 1994b). These measures were rank ordered from least to most expensive, with the following adjustments:

- locomotive controls were removed from the inventory because the inter-regional characteristics of the industry limited their effectiveness as a local control measure;
- mobile source transportation control measures (TCMs) were removed, including Employee Commute Options (ECO) and Group 1, 2, and 3 TCMs, because of the degree of uncertainty associated with estimations for reductions and costs per ton;
- unless Federal reform was selected as a VOC measure, it was deleted from the list of available NOx control measures prior to selection of the NOx attainment strategy; and
- if California Reform was selected for either VOCs or NOx, then Federal reform was also selected, because the California program was modeled incremental to the Federal program.

Once the inventory of control measures for each nonattainment area had been rank ordered by cost per ton of reduction, this RIA sequentially added control measures to the nonattainment area's control strategy until the sum of all selected precursor reductions met or just exceeded the targeted reductions established for that area.[7] In most cases this process resulted in all available control measures being selected without the targeted reduction being achieved. Unless the available control measures allowed for a strategy that included at least seventy five percent of the necessary VOC and NOx reductions for an area, that area was deemed to have "Residual Nonattainment", a condition which is discussed under section V(D)(4) of this RIA.

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7 VOC and NOx control measures have step-wise cost curves. Consequently, the need for an additional increment to reach targeted levels seldom resulted in an exact match between targeted and necessary reductions. Generally, when a small reduction was still needed, the next available control measure resulted in total reductions greater than the NOx target.

Current implementation strategies under subpart (2) allow for trading within a nonattainment area. In addition, if it can be shown that the control of a small number of sources can allow the nonattainment area to attain, then subpart (2) allows for the control of those identified sources and the exemption of other sources within the nonattainment area from having to reduce their own levels of pollution. The control measure selection process incorporated in this RIA precludes the use of trading within a nonattainment area because the least costly controls are always chosen as part of this analysis' control strategy. Any trading outside the control strategy determined by this RIA must, by construction, result in a higher cost. For the same reasons, local management of a single source or small group of sources and exempting other polluters would increase costs above those in this RIA. In areas of residual nonattainment, these points are moot, because no further controls have been identified outside the control strategy which could provide these sorts of flexibility. Therefore, for reporting purposes, this RIA identifies only "least cost" measures from its menu of available controls in determining the cost of attainment.

V(E) RESIDUAL NONATTAINMENT

Selection of controls to meet or exceed an area's VOC and NOx targets does not necessarily result in modeled attainment. In areas where there were enough controls available to achieve modeled reduction targets, areas with ozone concentrations greater than the standard could still exist for several reasons, including but not limited to:

- **hot spots:** The correct VOC and / or NOx reductions were identified and available, but because of source distribution, the selection of a least cost strategy proved ineffective. This type of residual nonattainment can be eliminated through an iterative process which identifies the correct control measures to eliminate hot spots.
- **speciation:** The correct VOC and / or NOx targets were identified and available but the most interactive precursors in the air column were not removed under the least cost strategy employed. As with hot spot residual nonattainment, successive modeling iterations can eliminate this type of residual nonattainment.
- **undercontrol:** The VOC and / or NOx targeted reductions were wrong and those included were insufficient for attainment, but additional unused control measures exist. When additional controls still remain in the areas inventory, undercontrol residual nonattainment can be eliminated by adding additional measures to the control strategy.

Clearly, the test for modeled attainment in any given area relies on the model's ability to incorporate emissions reductions and air chemistry. However, the Centroid method could not directly accommodate changes in emissions or air chemistry, so this analysis cannot identify hot-spots, speciation, or undercontrol. Therefore, this analysis assumes the VOC and NOx targets are correct for any given nonattainment area, subject to the results of any confirmation runs which may be run subsequent to the submission of this RIA.

In many cases, the physical inventory of available VOC and/or NOx controls could not provide the necessary tons of reductions needed to attain a nonattainment area's targets. When undercontrol of this sort occurs, the area cannot attain the standard. [8] These areas are defined as "residual nonattainment areas" (RNAs). This condition was not unexpected. Residual nonattainment has always been a problem. However, because of the separation between the standard setting and implementation processes of the NAAQS, the Agency does not believe the level of residual nonattainment reported in this RIA is necessarily correct. Instead, the conclusions drawn in this RIA must be considered as an upper bound, subject to improvement based on the additional flexibility and creativity that will be identified under the part 51 implementation process. Several factors mitigate the level of residual nonattainment expected in the year 2007:

Flexibility in Ozone Management: As this RIA has stated repeatedly, this analysis is only the first of a multi-step process. Under the restrictions of subpart (2) of the Act, the analysis is bound to a narrowly defined range of control mechanisms. With the promulgation of a new ozone standard the Agency will employ broader and more flexible control strategies. For example, additional flexibility may make it easier for nonattainment areas to employ market based mechanisms beyond their borders. Consequently, the application of greater flexibility in ozone management is a means to further reduce the problem of residual nonattainment.

Exogenous Efforts: Currently, there are a number of efforts under way which will reduce the level of ambient ozone and its precursors. For example, the South Coast Air Quality Management District in California, the Ozone Transport Commission (OTC) and the Lake Michigan Ozone Study (LMOS) area considering the application of regional ozone strategies. To some extent, these regional strategies are included in the baseline, which anticipates some sort of broad-based regional NOx control agreement. Comparisons between the LCS and RCS conclusions found in chapters VI and VII of this RIA provide an indication of the impact of such strategies on the residual nonattainment problem. Other efforts designed to reduce sulfur dioxide (SO2) and particulate matter (PM) emissions will have synergistic impacts on the overall concentration of ozone in urbanized areas. These synergies will be fully discussed as a component of the integrated part 51 implementation strategy for ozone, particulate matter, and regional haze.

Technological Change: Many of the control technologies used today did not exist when the current standard was originally promulgated, but were created in response to the regulatory needs of the Act. The analytical team believes that the trend for the innovation of better, faster, and cheaper controls will continue and that the current efforts to revise the NAAQS will act as a catalyst for their creation. A part of the residual nonattainment problem will be solved by new controls and process changes which will come into use before the year 2007.

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8 In these cases, the RIA does not attempt to "force" attainment. Allowing for many types of flexibility are beyond the strict subpart (2) scope of this RIA. Any further reductions of the residual nonattainment problem have been deferred until the completion of the implementation process under part 51, where issues of transport, flexibility, and co-control can be fully discussed in the context of a single (proposed) ozone standard.

Because of the tendency for ROM modeling to over-predict ozone concentrations under the one and eight hour averaging times (EPA, 1996d), there is a high probability that the actual VOC or NOx target for any given area will be less than 100% of the target identified for this RIA. Consequently, areas within this analysis identified as not having sufficient VOC or NOx control measures to achieve their targeted reductions may still be able to attain the standard. Based on discussions with EPA modelers and other scientists about the degree of ROM overprediciton, agency analysts picked 75% of an areas's targeted reductions as a lower limit for potential attainment. In other words, for areas which could not meet their appropriate standard by applying all available controls, if that area could achieve at least 75% of that target, it could be considered "within the range of uncertainty" and identified as an area of potential attainment. [9] The cost chapter reports both types of areas separately but combines then in its conclusions as areas which are able to attain. This assumption will be investigated further under the part 51 implementation process if necessary.

V(F) ESTIMATING PARTIAL ATTAINMENT AIR QUALITY

In the context of this analysis, the term post-control refers to the effects on air quality after control measures are applied but reflecting the existence of residual nonattainment. This post-control scenario is presented in contrast to the full attainment scenario for each baseline and all ozone alternatives. Resource constraints and data limitations prevent a comprehensive modeling to establish a direct relationship between ozone precursor emission reductions and ambient ozone air quality. Therefore, the benefits analysis uses a rollback procedure that directly reduces ambient ozone air quality to meet the attainment criteria of each alternative NAAQS. For the full attainment scenario, this rollback procedure is applied independent of the control measures identified in the cost analysis. However, benefits associated with full attainment of a NAAQS are not directly comparable to the cost estimates presented in this RIA due to the presence of residual nonattainment. Therefore, a second scenario for estimating benefits was established. This scenario is referred to as the post-control scenario because it is intended to reflect the degree of emissions control that the cost analysis identifies as being available for each identified nonattainment area. Since predicted residual nonattainment areas are identified in the cost analysis, the benefits estimates for a post-control scenario will be smaller than the benefits estimates for a full attainment scenario.

Recognizing that the photochemistry behind ozone formation is not linear but also recognizing that air quality modeling results were not available for estimating post-control air quality, and given the need to provide benefit and cost estimates that reflect relatively comparable air quality, the post-control

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9 For instance, Philadelphia's 8H1AX-80 target under the Local Control Scenario called for an 80% reduction of VOCs, approximately 800 tons per day (tpd). Therefore, this RIA would have considered Philadelphia "within the range of uncertainty" if it could have achieved at least 75% of that target, or 600 tpd. Under the Regional Control Scenario, Philadelphia's target was 88% of its original target, or about 700 tpd. Given the level of uncertainty associated with this analysis, however, the RIA would have considered Philadelphia to be "within the range of uncertainty" if it could achieve at least 75% of that target, or about 530 tpd.

scenario uses a linear assumption between the VOC and NOx target achieved and the effect on baseline ozone air quality. For example, if the cost analysis shows that a nonattainment area can only achieve half of its targeted reductions, the post-control scenario would reflect this residual nonattainment by rolling back air quality to only half the distance between the baseline ozone concentration and the concentration specified by each ozone alternative. From this methodology, the benefits analysis was able to estimate benefits reflective of the degree of residual nonattainment identified for each nonattainment area in the costs analysis. This adjustment for the post-control scenario allows benefit and cost estimates to be considered on a more comparable basis.

V(G) REFERENCES

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VI. EMISSION REDUCTION AND COST ANALYSIS OF OZONE ALTERNATIVES

VI(A) INTRODUCTION

After carefully considering the information presented in the Criteria Document, the Staff Paper, and the advice and recommendations of CASAC, the Agency proposes replacing the existing one hour primary ozone standard with a new eight hour 0.08 ppm primary standard. The proposed standard would be met at an ambient air quality monitoring site when the three year average of the annual third highest daily maximum eight hour average ozone concentration is less than or equal to 0.08 ppm.

The alternative standards analyzed for this RIA are all forms with an eight hour averaging time. Chapter IV of this RIA contain detailed discussions of the methodology used to predict ozone concentrations in the analytical year 2007. These predictions were used to identify counties which failed to meet each of six alternatives: the current one hour, one expected exceedance 0.12 ppm standard (1H1EX-120); an eight hour, fifth highest average[1] daily maximum concentration based 0.08 ppm standard (8H4AX-80); an eight hour, five expected exceedances 0.08 ppm standard (8H5EX-80); an eight hour second highest average daily maximum concentration based 0.08 ppm standard (8H1AX-80); an eight hour third highest average daily maximum eight hour average ozone concentration 0.09 ppm standard (8H2AX-90); and an eight hour fifth highest average daily maximum eight hour average ozone concentration 0.07 ppm standard (8H4AX-70).[2] The 8H4AX-80 and the 8H1AX-80 forms bound the proposed standard. The 0.07 ppm and 0.09 ppm forms allow for analysis of the full range of CASAC recommendations. While this RIA does not analyze the proposed standard directly, the selected alternatives bound the costs, benefits, and economic impacts which the staff expects will result from the proposed standard under the analytical framework of this RIA.

To better approximate the rounding convention utilized in monitoring, the actual ozone concentration level that resulted in an exceedance was .005 ppm greater than the standard, i.e., for 0.12 ppm, an actual exceedance of the standard was not recorded unless the modeled ozone concentration was greater than or equal to .125 ppm; for an 0.08 ppm standard, the modeled concentration level was .085 ppm. No rounding convention was applied to the ozone concentration levels established for marginal nonattainment.

The staff performed its analysis against a baseline which included the following:

- **Full implementation of current Clean Air Act Amendments of 1990 Amendments.** A discussion of this assumption can be found in chapter IV of this RIA.

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1 For all of the standards analyzed, the averaging time is three years.

2 As stated earlier in this RIA, resource constraints precluded the direct analysis of the 0.07 ppm and the 0.09 ppm alternative standards. However, the staff analyzed existing hourly monitored data reconfigured to provide eight hour averages and determined a fifth highest average daily maximum ozone concentration at 0.07 ppm is analytically similar in the size, location, and number of nonattainment areas to the 8H1AX-80 form and that a third highest average daily maximum ozone concentration at 0.09 ppm is analytically similar to the current 1H1EX-120 standard. Therefore, within the range of this analysis' uncertainty, the Staff believes the 8H4AX-70 has the same economic impacts and costs as the 8H1AX-80 form. Similarly, the Staff believes the 8H2AX-90 form has the same costs and economic impacts as the current 1H1EX-120 form.

- **Current implementation techniques mandated under subpart (2) of the Act hold.** The staff believes the most reasonable implementation strategy for this RIA would be the strict application of subpart (2) requirements, leaving any future flexibility to the analysis performed for the part 51 implementation strategies.[3]
- **Implementation of a regional NOx strategy in the East which approximates the efforts of current regional efforts by OTAG, CAPI, and other on-going efforts.** Current efforts to address long range NOx transport issues include the Clean Air Power Initiative (CAPI), efforts to expand the OTR requirements to the thirty seven Eastern United States. While these efforts are not complete, the staff anticipates their implementation far in advance of the 2007 air quality assessment undertaken for this RIA. The staff believes that these efforts will be in place in the year 2007, and because they are being undertaken to attain the current ozone NAAQS, they should be included in the analytical baseline of this RIA.

Current regional transport efforts affect this RIA's baseline air quality by: (a) significantly reducing the affect of long range NOx transport in the East, (b) reducing the number of nonattainment areas under each alternative and the targeted reductions necessary within those that remain, and (c) reducing the number of residual nonattainment areas under each alternative. For purposes of identification, this RIA's analytical baseline will be referred to as the "Regional Control Scenario" (RCS).

The staff also performed sensitivity analysis on its cost and benefits work under a second baseline which did not allow for the inclusion of regional control strategies in the East. While efforts are under way at this time to implement several regional NOx strategies in the East, these efforts are not in place at this time. While the staff believes regional measures represent a truer picture of the anticipated 2007 air quality, it must still present an accurate assessment of the potential costs of the rulemaking. Therefore, this second baseline, refereed to in this RIA as the "Local Control Scenario" (LCS), provides an upper bound to the anticipated costs of the new ozone NAAQS in the event regional efforts fail to arise before 2007. LCS results appear at the end of this chapter, behind those of the analytical baseline (RCS).

VI(B) EMISSION REDUCTIONS AND COSTS UNDER THE REGIONAL CONTROL SCENARIO

Concurrent with the staff's analysis of a new ozone NAAQS, other efforts are under way which affect the 2007 analytical base case and base line. Thirteen Northeastern States and the District of Columbia united to form a single Ozone Management Region (OTR). Based upon their approach, a

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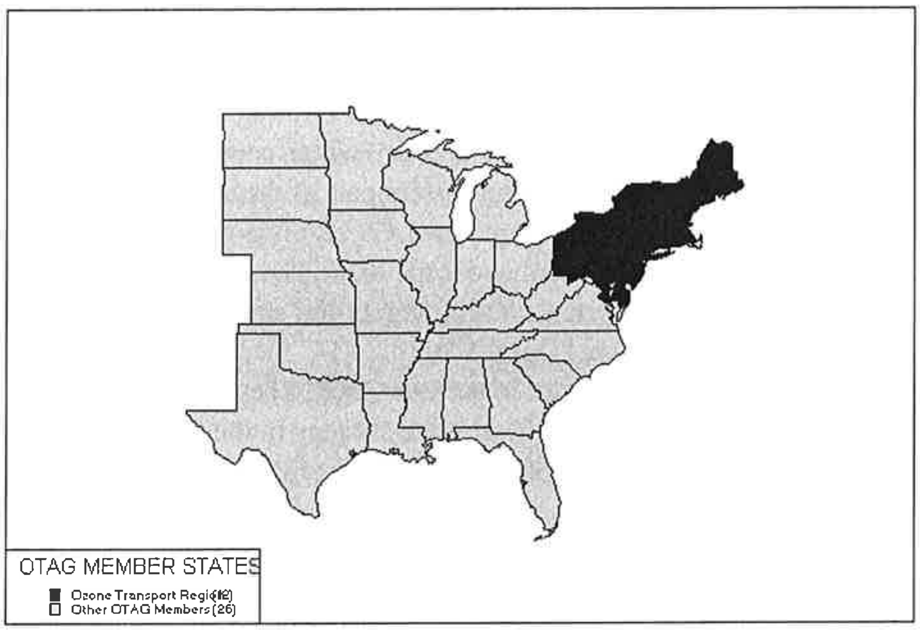
3 Although the staff is currently working closely with industry leaders to craft an implementation strategy that will allow for much greater flexibility for attainment in any given area, these strategies do not exist at the present time, nor does the staff know what they will look like. Consequently, any attempt to anticipate those strategies would (a) miss some strategies which will be applied, (b) include some strategies which will not be included, and (3) create unnecessary complications to this analysis.

larger organization has been formed out of the thirty seven Eastern-most States and D.C., called the Ozone Transport Assessment Group (OTAG). Figure VI-1 displays the OTAG membership. Currently, OTAG plans to apply regional strategies to address transport issues.

FIGURE VI-1
OTAG MEMBER STATES



While the regional NOx control efforts mentioned above are not complete, it is prudent to incorporate the expected VOC and NOx reductions from their efforts into the 2007 base line. The following analysis includes, for the OTAG States, the application of a 0.15 pounds per million BTU cap on NOx emissions from utilities and other combustion boilers and a California styled LEV program. These strategies are applied as a part of the analytical baseline but should not be interpreted as a recommendation for, or a prediction of the results of any of the above efforts. Instead, the strategies included in the baseline are "placeholders" in anticipation of the successful completion of these efforts.. Identification of nonattainment areas and the strategies necessary to attain the standard follow the requirements of subpart (2). The economic impacts of the regional and local controls necessary to attain each of the alternative standards can be found in the next chapter of this RIA.

Current OTAG efforts have focused on a number of alternative scenarios, which the staff compared to its own estimate of potential controls. In every case but the most extreme, the OTAG strategies represent a lower level of control than that included in this RIA. However, the staff's projected regional strategy was not designed to represent OTAG alone. Instead, it was designed to approximate the expected reductions of a number of different regional efforts *at the same time.* Therefore, given that OTAG represents only a part of the regional control predicted in this RIA, estimates of air quality improvements can be considered reasonable. References to the States included in this RIA's regional scenario will be referred to as "the RCS States".

VI(B)(1) SUMMARY OF TOTAL EMISSION REDUCTIONS AND CONTROL COSTS BY NONATTAINMENT AREA

Regional controls apply to only the ROM domain, which contains all of the thirty one Eastern United States included in the RCS States and the eastern part of the six remaining RCS States. For areas west of the ROM domain, the staff assumed the LCS baseline was a reasonable approximation of the ozone concentrations that would be found under the RCS. The methodologies employed for identifying nonattainment areas, appropriate control targets and strategies, and the level of RNA for each alternative can be found in chapters IV and V of this RIA. Section VI(B)(1)(a) describes the costs associated with attaining the current standard in the year 2007. They show that current Clean Air Act requirements, even in conjunction with a regional NOx strategy in the East, must be augmented by additional local controls to achieve the standard. These costs are a part of the baseline, and are presented for purposes of completeness. The costs associated with each alternative standard are marginal costs, above the baseline. In other words, the costs associated with each alternative below are the costs above and beyond those associated with the current standard. As stated before, one must remember the baseline costs for the current standard and tho marginal costs associated with each alternative do not represent full attainment in every area of the country.

The National Low Emission Vehicle (NLEV) program and regional NOx controls on utilities constitute the bulk of the regional controls included in the baseline. The cost of the NLEV program - a voluntary initiative under development by the automobile industry and a group of states - is projected to be over $600 million per year (EPA, 1996b). The utility NOx reductions were evaluated as part of the Clean Air Power Initiative (CAPI) report recently issued by EPA. By interpolating between 2005 and 2010, it is possible to derive a cost estimate for a 0.15 pound per million Btu control strategy. That cost is $2.3 billion for the year 2007.

Tables VI-2, 3, 4, 7, 8, and 9 below show the marginal control cost of attaining alternative standards under the RCS or the sensitivity analysis LCS. Frequently, these tables show zero costs for VOCs, NOx, or both. This does not mean that there is no additional cost to attaining the alternative standard in these areas. Instead, it means that the menu of modeled controls has been exhausted and that there are no more controls to employ, even though the alternative standard is more restrictive than the current standard. Consequently, the proper interpretation of the total cost from the 2007 baseline (for the LCS, and with the regional control strategies included for the RCS,) for any eight hour

NAAQS alternative is to sum the marginal costs for that area with the total costs for that area under the current standard. For example, Table VI-3 lists the marginal cost for available controls necessary to attain the 8H4AX-80 standard in Baton ROuge as \$16.1 million per year. Under Table VI-1 for the current standard, the cost for Baton Rouge to attain the current standard is \$14.5 million per year. Therefore, from the 2007 baseline, after implementing regional NOx control measures, the cost of available controls to directly attain the 8H4AX-80 standard is (\$16.1 + \$14.5), or \$30.6 million per year. For Bakersfield, however, the data show different information. Table VI-3 indicates the marginal control cost for Bakersfield is zero, while Table VI-1 lists the total control cost for Bakersfield toward attaining the current standard is \$7.9 million per year. This indicates that the menu of available controls for attaining the current standard was exhausted and that, even though the 8H4AX-80 standard is more restrictive, no additional controls could be applied to attain it.

The implementation strategies which are now under discussion by the broad stakeholder group consider additional factors which allow for more areas to attain. Appendix A, Table 1 shows the modeled nonattainment area counties for the current standard. Appendix A, Tables 2, 3, and 4 show the modeled nonattainment counties for the 8H5EX-80, 8H4AX-80 and 8H1AX-80 standards, respectively. The tables include all identified nonattainment areas, including areas expected to be classified as marginal nonattainment.

VI(B)(1)(a) THE CURRENT STANDARD (1H1EX-120) AND THE 8H3AX-90 ALTERNATIVE

40 CFR part 50 establishes the current ozone primary standard as: "0.12 part per million (235$\mu g/m^3$) . . . attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 part per million (235$\mu g/m^3$) is equal to or less than one . . ." [4] Appendix H to 40 CFR part 50 describes "expected exceedance" as the arithmetic mean over three years of the total number of exceedances of the standard. Because the data for this analysis covered only a single year, this analysis assumed the three analogous monitored values for each averaging year will be the same. In this way, a single year's worth of data can fully describe the three year averaging period. For the average number of exceedances over three years to be greater than one, there must be at least four exceedences in three years. Since the highest value in the analysis' model represents three years' worth of identical data, the fourth highest value over three years - the one that would trigger nonattainment - must necessarily be the same as the second daily highest value from the modeled data. In other words, the design value for each county was established by identifying the highest value for each day, removing that day from the analysis, and selecting the highest remaining daily value.

The 1H1EX-120 and the 8H2AX-90 forms of the standard are analytically the same. Therefore, the remainder of this discussion will refer only to the 1H1EX-120 form with the clear

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4 40 Code of Federal Regulations part 50, §50.9(a).

understanding that the discussion applies equally to both forms. The staff identified thirty four modeled nonattainment counties in the year 2007 for the current 1H1EX-120 standard. Assigning these counties to nonattainment areas added an additional forty seven counties, for a total of eighty one counties in twenty nonattainment areas. These areas ranged in size from twenty three counties in the New York nonattainment area to single county nonattainment areas in Bakersfield, Fairfield, New Haven, Reno, San Diego, Santa Barbara, and Visalia. Ten of the identified nonattainment areas were within the Regional Oxidant Model (ROM) domain. California had fifteen counties in seven nonattainment areas. Three areas were located in Non-ROM-Not-California (NRNC) areas. Fourteen of the twenty nonattainment areas had a maximum expected ozone concentration of less than 138 ppm and therefore were considered to be in "marginal" nonattainment.

TABLE VI-1
Total Costs for the Current (1H1EX-120) and 8H2AX-90 Standards In the Year 2007

Area	VOC Cost *	NOx Cost *	TOTAL COST*	Area	VOC Cost *	NOx Cost *	TOTAL COST*
Bakersfield	$7.9	$0.0	$7.9	Los Angeles	$265.7	$0.0	$265.7
Baton Rouge	$14.5	$0.0	$14.5	New York	$271.8	$192.0	$463.8
Houston *	$416.7	$0.0	$416.7	San Diego	$43.9	$0.0	$43.9
				TOTALS	**$1,020.5**	**$192.0**	**$1,212.5**

* In Millions of 1990 dollars
Shaded area indicates where the available VOC and NOx control measures were considered sufficient to attain the standard, asterisks indicate areas within the range of uncertainty which could potentially attain while achieving less than 100% of their targeted reductions.

The six remaining nonattaiment areas would require VOC or NOx control strategies to reduce ozone concentrations to the level of the standard. These areas included Bakersfield, Los Angeles, and San Diego in the West; and Baton Rouge, Houston, and New York in the East, totaling forty one counties, seven in the West and thirty four in the Eastern United States. In the East, modeled ozone concentrations ranged from 146 ppm in New York to 173 ppm in Houston. Los Angeles recorded the highest expected 2007 ozone concentration of 276 ppm. These costs are a part of the baseline and are reported here for purposes of completeness. Of the six nonattainment areas which would require the application of control measures, Baton Rouge was the only area able to reach its targeted reductions. Of the remaining five, Houston was the only area which was able to reach at least seventy-five percent of its targeted emissions.[5] Houston was identified as an area within the range of uncertainty for this

5 c.f., Chapter V, section E for a discussion of this assumption.

analysis and counted as a potential attainment area. The remaining four nonattainment areas were identified as having residual nonattainment.

Table VI-1 lists the costs for nonattainment areas expected to require additional control measures to achieve the current standard, given the implementation of CAA requirements and a regional strategy in the East. Appendix B, Table B-1 lists the counties within each of the current standard nonattainment areas. The VOC and NOx targets established to attain the current standard after the imposition of RCS baseline items result in an expected reduction of approximately 38 thousand tons of NOx per year and 333 thousand tons of VOC. NOx reductions above and beyond the CAAA requirements necessary to attain the current standard will cost an expected $192 million annually. VOC reductions will cost another $1 billion, for a total baseline cost to achieve the current standard of $1.2 billion per year, or roughly, $5 per year per capita.[6]

VI(B)(1)(b) ALTERNATIVE 8H5EX-80

The staff identified seventy three modeled nonattainment counties in the year 2007 for the 8H5EX-80 standard. Assigning these nonattainment counties to nonattainment areas added ninety two more counties, for a total of 167 nonattainment counties in thirty one nonattainment areas. New York contained the largest number of counties with twenty three. Eight areas became single county nonattainment areas. Twenty of the identified nonattainment areas were in the ROM domain. Nine areas were in California and two were located in NRNC areas.

Twenty one of the thirty one identified nonattainment areas had a maximum estimated ozone concentration of less than .092 ppm[7]. Of the remaining ten, five were in the ROM domain and five were in California. None of the remaining nonattainment areas were in the NRNC domain. Table VI-2 lists the costs for nonattainment areas where VOC or NOx controls would be required. Appendix B, Table B-2 lists the counties within each of the 8H5EX-80 nonattainment areas. None of the ten Greater-Than-Marginal nonattainment areas could achieve their VOC or NOx targets for the 8H5EX-80 standard, and only Baton Rouge and Houston were able to achieve at least seventy five percent of their targets. Consequently, the staff identified Baton Rouge and Houston as the only 8H5EX-80 areas potentially able of attaining the standard and defined the other eight nonattainment areas as residual nonattainment.

The VOC and NOx strategies for the 8H5EX-80 standard result in an expected reduction of approximately 23 thousand tons of NOx and 27 thousand tons of VOC per year beyond the reductions which occur to as part of the baseline. NOx reductions beyond those necessary to attain the current

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6 The ozone NAAQS is a national rule, potentially affecting every citizen of the United States. Therefore, the staff employed a per capita valuation which distributed costs across the entire United States, rather than for just the populations within nonattainment areas.

7 92 ppm was determined to be an analogous Marginal nonattainment level for an eight hour standard. A discussion of this value and the methodology employed to achieve it can be found in Chapter IV(D)(2): "Identification of Marginal Nonattainment Areas".

standard in 2007 will cost approximately $117 million annually. The annual cost of additional VOC controls will run an expected $138 million. The staff estimates the total marginal cost to achieve the 8H5EX-80 standard at $255 million per year, or about $1 annually per capita.

Most of the costs arise from the inclusion of additional nonattainment areas relative to the identified areas which required additional controls beyond the 2007 baseline to achieve the current standard. This makes cost comparisons misleading. While the stringency of the standard appears to have increased from the current standard, the availability of controls has not. Areas where the staff predicts current standard residual nonattainment area also areas of predicted residual nonattainment for each (more stringent) alternative standard as well. Therefore, while precursor

TABLE VI-2
Marginal Costs for the 8H5EX-80 Standard
In the Year 2007

Area	VOC Cost *	NOx Cost *	Total Cost *	Area	VOC Cost *	NOx Cost *	Total Cost *
Atlanta, GA	$76.6	$110.8	$187.3	Houston, TX *	$0.0	$0.0	$0.0
Atlantic City	$3.3	$6.1	$9.4	Los Angeles, CA	$0.0	$0.0	$0.0
Bakersfield, CA	$0.0	$0.0	$0.0	New York, NY	$0.0	$0.0	$0.0
Baton Rouge, LA *	$16.1	$0.0	$16.1	Sacramento, CA	$22.2	$0.0	$22.2
Fresno, CA	$19.3	$0.2	$19.4	San Diego, CA	$0.0	$0.0	$0.0
				TOTALS	**$137.5**	**$117.0**	**$254.5**

* In Millions of 1990 dollars
Shaded area indicates where the available VOC and NOx control measures were considered sufficient to attain the standard, asterisks indicate areas within the range of uncertainty which could potentially attain while achieving less than 100% of their targeted reductions.

targets increase to accommodate the stricter standard, there are no additional controls available to address this increase. Of the six current standard areas predicted to need additional control beyond the RCS baseline, only Baton Rouge had an increase in control measures. This increase happened because the additional stringency of the 8H5EX-80 standard increased the size of the Baton Rouge nonattainment area by one county. For the other five areas, either they were areas of residual nonattainment and had no additional controls available, or they were new nonattainment areas (e.g., Atlanta) and had positive marginal costs. The economic impacts of the 8H5EX-80 standard are fully discussed in Chapter VII "Summary of potentially Affected Entities" and Chapter VIII "Economic Assessment".

VI(B)(1)(c) ALTERNATIVE 8H4AX-80

For the 8H4AX-80 standard, the staff identified eighty five modeled nonattainment counties in the year 2007. Assigning these nonattainment counties to nonattainment areas added an extra 117 counties, for a total of 202 nonattainment counties in thirty seven nonattainment areas. The New York nonattainment area contained twenty three counties, the largest for the 8H4AX-80 standard. Ten areas became single county nonattainment areas. Twenty six of the identified nonattainment areas were in the ROM domain., an additional eight areas were in California and three were located in NRNC areas. Shaded area indicates where the available VOC and NOx control measures were potentially sufficient to attain the standard.

TABLE VI-3
Marginal Costs for the 8H4AX-80 Standard
In the Year 2007

Area	VOC Cost *	NOx Cost *	Total Cost *	Area	VOC Cost *	NOx Cost *	Total Cost *
Atlanta, GA	$77.6	$110.8	$187.3	Modesto, CA	$7.0	$0.0	$7.0
Atlantic City	$3.3	$6.1	$9.4	New York, NY	$0.0	$0.0	$0.0
Bakersfield, CA	$0.0	$0.0	$0.0	Philadelphia, PA	$237.5	$83.1	$320.6
Baton Rouge, LA	$16.1	$0.0	$16.1	Portland, OR *	$40.9	$2.9	$43.9
Fresno, CA	$19.3	$0.2	$19.4	Sacramento, CA	$22.2	$0.0	$22.2
Houston, TX *	$0.0	$0.0	$0.0	San Diego, CA	$0.0	$0.0	$0.0
Los Angeles, CA	$0.0	$0.0	$0.0	Visalia, CA	$3.8	$0.0	$3.8
				TOTALS	**$423.0**	**$203.0**	**$626.0**

* In Millions of 1990 dollars
Shaded area indicates where the available VOC and NOx control measures were considered sufficient to attain the standard, asterisks indicate areas within the range of uncertainty which could potentially attain while achieving less than 100% of their targeted reductions.

Twenty three of the thirty seven nonattainment areas had a maximum estimated ozone concentration of less than 92 ppm. Of the remaining fourteen nonattainment areas, six were in the ROM domain, seven were in California, and one was in the NRNC domain. Table VI-3 lists the nonattainment areas for which VOC or NOx controls would be required. Appendix A, Table A-3 lists the counties within each of the sixty eight 8H4AX-80 nonattainment areas. Only the Portland, Oregon nonattainment area could reach its targeted reductions. Of the remaining thirteen nonattainment areas, only Houston had sufficient control measures available to reach at least seventy five percent of its target and was determined to be within the range of uncertainty and potentially able to attain the standard. The remaining twelve areas have residual nonattainment.

The VOC and NOx targets found in Table VI-3 result in an expected marginal reduction of approximately 50 thousand tons of NOx and 115 million tons of VOC per year. NOx reductions beyond the analytical baseline and any additional reductions necessary to attain the current standard will have a marginal cost of about $203 million annually. VOC reductions will have a marginal cost of about $423 million annually. Total predicted marginal costs for the 8H4AX-80 standard will reach about $626 million annually. On a per capita basis, the marginal cost of the 8H4AX-80 standard relative to the current standard, is approximately $3 per year. Chapters VII "Summary of potentially Affected Entities" and Chapter VIII "Economic Assessment" of this RIA include discussions of the affects of the strategies used to meet the 8H4AX-80 standard.

VI(B)(1)(d) ALTERNATIVES 8H1AX-80 AND 8H4AX-70

The 8H1AX-80 and the 8H4AX-70 forms of the standard are analytically the same. Therefore, the remainder of this discussion will refer only to the 1H1EX-120 form with the clear understanding that the discussion applies equally to both forms. The staff identified 236 modeled nonattainment counties in the year 2007 for the 8H1AX-80 standard. When these nonattainment counties were assigned to nonattainment areas, 191 additional counties were added, for a total of 427 nonattainment counties in seventy five nonattainment areas. The Washington D.C. / Baltimore nonattainment area contained the largest number of counties, with twenty nine
counties. Seventeen counties became single county nonattainment areas, seven in the West and ten in the East. The staff classified five Eastern single county nonattainment areas as marginal. Fifty seven of the identified nonattainment areas were in the ROM domain. Thirteen nonattainment areas were in California and five areas were located in NRNC areas. Thirty five of the seventy five nonattainment areas had a maximum estimated ozone concentration of less than 92 ppm. Of the remaining forty, twenty five were in the ROM domain, nine were in California, and six were in the NRNC domain. Three of the forty nonattainment areas for which controls needed to be identified were able to achieve their targeted reductions. Thirteen more areas could reach at least seventy-five percent of their targeted reductions and were determined to be within the analysis' range of uncertainty. These areas were identified as potentially able to achieve the standard. The remaining twenty-four nonattainment areas were identified as areas of residual nonattainment. Table VI-4 lists the nonattainment areas for which VOC or NOx controls would be required to attain the 8H1AX-80 standard. Appendix A, Table A-4 lists the counties within the 8H1AX-80 nonattainment areas

. VOC and NOx targets result in an expected reduction of approximately 290 thousand tons of NOx per year and about 660 thousand tons of VOC beyond that necessary to meet the current standard. Marginal NOx reductions will cost an expected $702 million annually, and marginal VOC reductions will cost another $1.8 billion, for a total marginal cost to achieve the 8H1AX-80 standard of $2.5 billion per year. The marginal cost per capita for control measures to attain the 8H1AX-80 standard is about $10 per year. The economic impacts of the 8H5EX-80 standard are fully discussed in Chapter VII "Summary of potentially Affected Entities" and Chapter VIII "Economic Assessment".

TABLE VI-4
Marginal Costs for the 8H1AX-80 and 8H4AX-70 Standards In 2007

Area	VOC Cost *	NOx Cost *	Total Cost *	Area	VOC Cost *	NOx Cost *	Total Cost *
Atlanta, GA	$80.6	$121.2	$201.8	Muskegon	$7.9	$2.8	$10.7
Atlantic City	$3.3	$6.1	$9.4	Nashville, TN *	$22.0	$43.3	$65.4
Bakersfield, CA	$0.0	$0.0	$0.0	New London, CT	$23.3	$20.4	$43.7
Balt./Wash. D.C.	$79.3	$2.0	$81.3	New Orleans, LA *	$1.9	$3.5	$5.4
Baton Rouge, LA	$16.1	$0.0	$16.1	New York, NY	$0.0	$0.0	$0.0
Beaumont, TX	$193.4	$0.0	$193.4	Philadelphia, PA	$237.5	$83.1	$320.6
Chicago, IL	$196.0	$111.1	$307.1	Phoenix, AZ	$54.3	$2.4	$56.7
Cincinnati, OH *	$62.4	$32.0	$94.4	Portland, ME *	$0.1	$17.7	$17.9
Dallas, TX *	$172.3	$4.1	$176.4	Portland, OR *	$41.7	$3.5	$45.2
Eugene, OR	$3.1	$1.9	$5.0	Providence, RI	$22.1	$13.8	$36.0
Fairfield	$10.9	$14.3	$25.2	Redding, CA	$4.7	$1.7	$6.4
Fresno, CA	$22.6	$0.6	$23.2	Reno, NV	$6.3	$0.2	$6.5
Grand Rapids, MI *	$69.6	$14.2	$83.8	Sacramento, CA	$23.2	$0.7	$23.9
Hartford, CT	$26.7	$22.4	$49.1	St. Louis, MO *	$232.0	$47.7	$279.7
Houston, TX *	$6.6	$0.1	$7.2	San Diego, CA	$0.0	$0.0	$0.0
Huntington, WV	$21.5	$6.0	$27.5	Santa Barbara, CA	$4.1	$0.2	$4.3
Knoxville, TN *	$48.2	$41.3	$89.5	Seattle, WA	$93.3	$80.4	$173.7
Los Angeles, CA	$0.0	$0.0	$0.0	Stockton, CA	$6.8	$0.0	$6.8
Manitowoc	$7.9	$2.5	$10.4	Tell City *	$0.2	$0.3	$0.4
Modesto, CA	$7.0	$0.0	$7.0	Visalia, CA	$4.2	$0.0	$4.2
				TOTALS	**$1,813.1**	**$702.0**	**$2,515.1**

* In Millions of 1990 dollars
Shaded area indicates where the available VOC and NOx control measures were considered sufficient to attain the standard, asterisks indicate areas within the range of uncertainty which could potentially attain while achieving less than 100% of their targeted reductions.

VI(B)(2) THE SECONDARY STANDARD

The costs and health benefits of a separate secondary standard have not been estimated. However, a number of inferences can be made from the results of the welfare benefits analysis under the full attainment scenarios. For the proposed standard, monetized benefits from commodity crops of the most stringent secondary standard incremental to the primary standard are close to zero. This indicates that the proposed primary standard is binding for those areas where commodity crops are grown (which includes California). For these areas, there would be no incremental improvements and, therefore, no additional costs or health benefits. For areas where we do not know if the proposed primary standard is binding (areas where commodity crops are not grown), the air quality database created to perform the commodity crops analysis could be used to estimate any additional health benefits. These benefits are expected to be small because the benefits curves flatten as the air quality improves marginally. The costs, if existing, would be best determined under the implementation strategies developed under the part 51 rule.

VI(C) COMPARISON OF ALTERNATIVE PRIMARY STANDARDS

As stated above among the caveats, one must be careful when comparing alternative forms of the standard. As the above analyses indicate, each alternative reaches a different endpoint *vis a vis* the location, size, and degree of residual nonattainment. Therefore, while it may appear straight forward to infer one of the alternative standards is more costly than the current standard, that conclusion is not appropriate. However, the Staff Paper sets out a process through which different standards can be compared (EPA, 1996). In Appendix A of the Staff Paper, the Agency equates the five expected exceedance form of the 0.08 ppm eight hour ozone standard with the fifth highest average daily maximum ozone concentration 0.08 ppm eight hour form, based on three considerations: (1) the same year's inventory data, (2) the same meteorology applied to each standard, and (3) the same number of identified nonattainment counties under each standard. Given the first two conditions hold for this RIA, similar conclusions can be reached here. If a standard has more nonattainment counties associated with it, one can reasonably expect that standard to provide greater protection than a standard with fewer identified nonattainment counties. In this manner, the application of 1990 inventory data grown to 2007 and 1987 meteorology indicates the least protective form of the standard examined is the current 1H1EX-120 form. In order of increasing protection, the 8H5EX-80 form ranks second, the 8H4AX-80 form ranks third, and the 8H1AX-80 form is the most protective.

Costs are not a reliable metric, but for another reason. While it is true that costs increase as the rank ordering of the three alternatives increases, the differences in cost, (or, more directly, the *lack* of differences) are an artifact of the maximal application of control measures within areas which experience residual nonattainment. For example, Tables VI-2, 3, and 4 lists a zero marginal cost for each alternative standard in Los Angeles. Because Los Angeles is a residual

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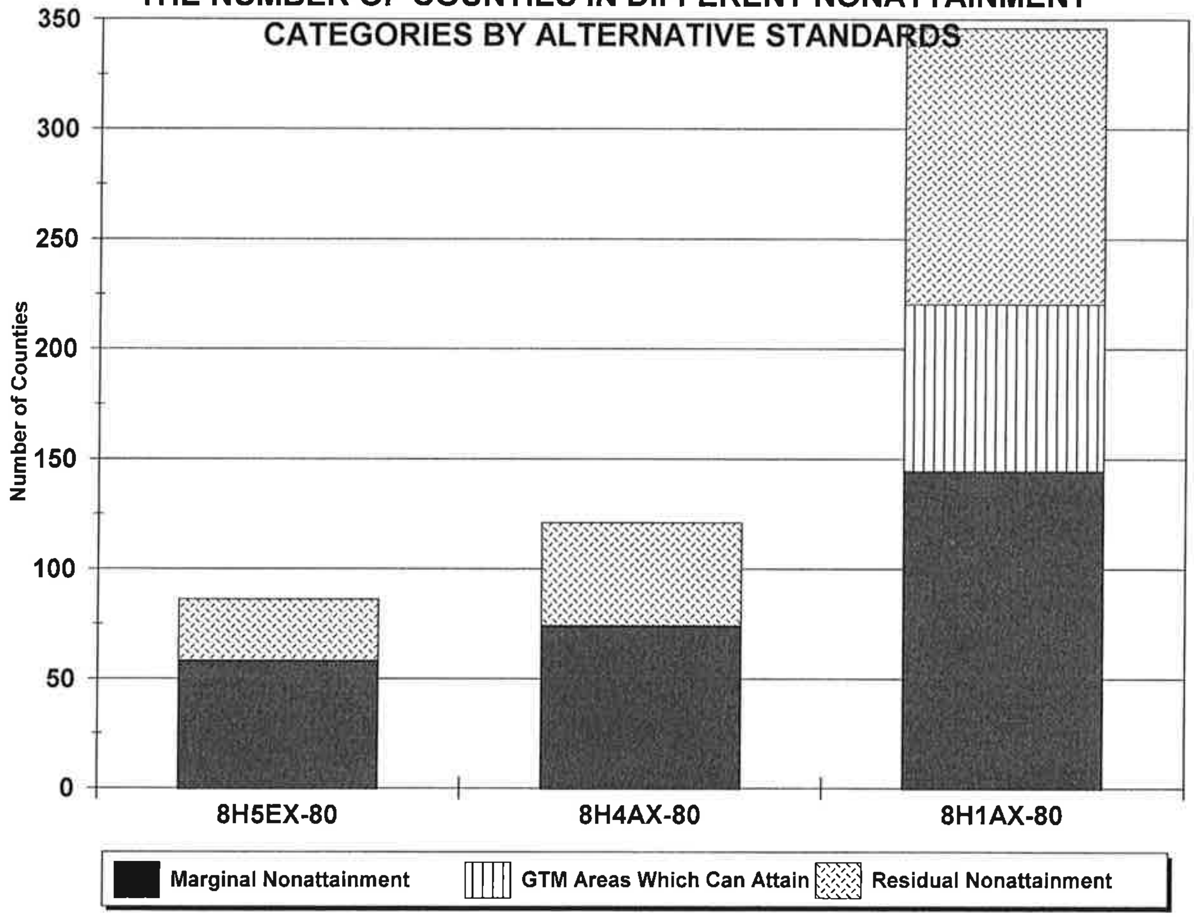
nonattainment area for each eight hour standard analyzed in this RIA, the true cost of attaining each alternative standard in Los Angeles cannot be determined. Consequently, while it may offer some insight into the relative costs associated with each standard, aggregate total costs underestimate the true cost of each alternative to such an extent that the metric's reliability must be limited. The usefulness of cost as a measurement of relative severity cannot be applied even within the same nonattainment area. Again using Los Angeles as an example, one would expect the strategies associated with increasingly restrictive standards to require increasing numbers of controls. Because the definition of Los Angeles' nonattainment area does not change between standards, neither does the set of control measures within each control strategy. While this may seem obvious, less apparent is the situation within Atlanta. A nonattainment area under each alternative, the 8H5EX-80 and the 8H4AX-80 forms include the same twenty counties in

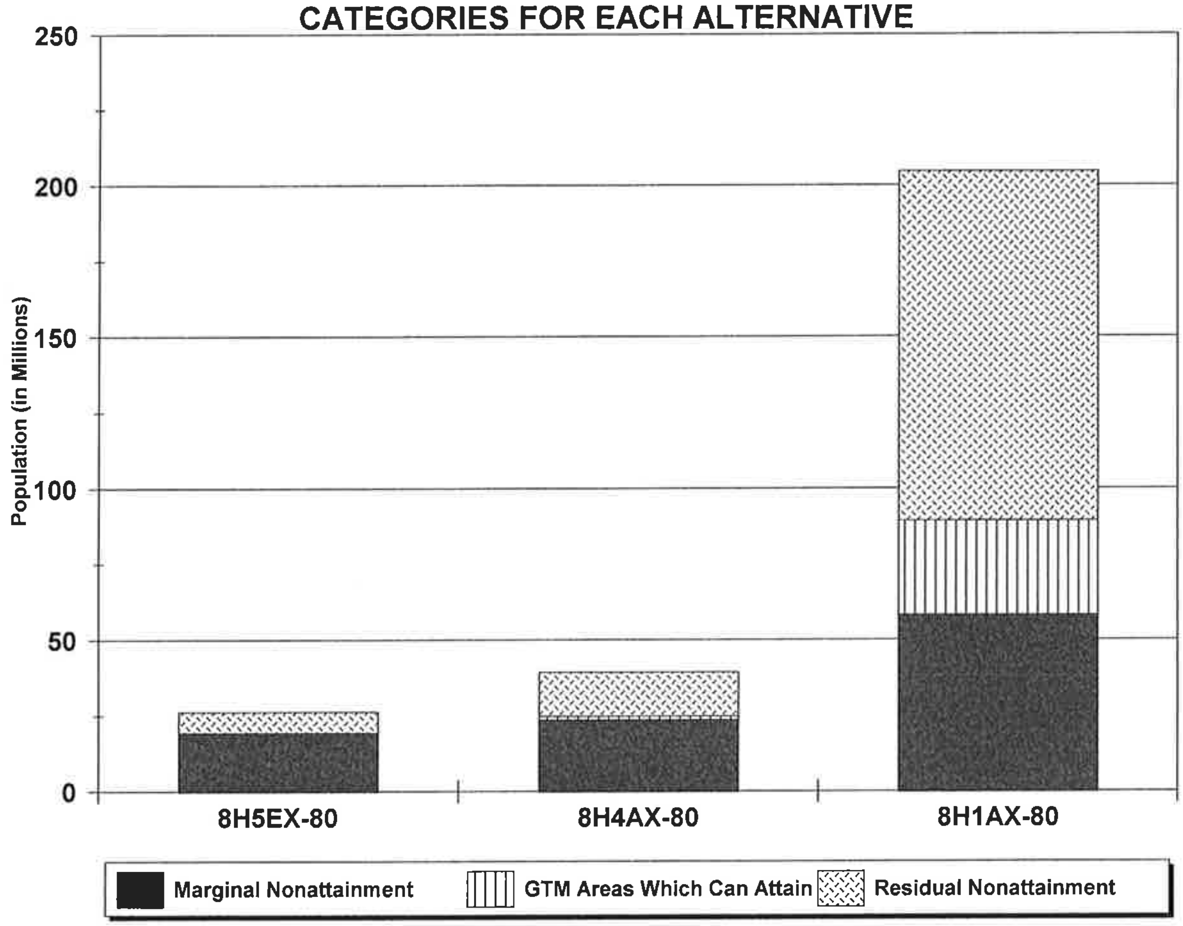
FIGURE VI-1
THE NUMBER OF COUNTIES IN DIFFERENT NONATTAINMENT CATEGORIES BY ALTERNATIVE STANDARDS



GTM refers to areas in categories "Greater Than Marginal"

Atlanta's nonattainment area definition. However, for the most stringent eight hour standard, five more counties join the Atlanta nonattainment area definition. The additional $6 million associated with these five counties represents the inclusion of all available controls in the Atlanta control

FIGURE VI-2
THE MARGINAL INCREASE IN POPULATION WITHIN NONATTAINMENT CATEGORIES FOR EACH ALTERNATIVE

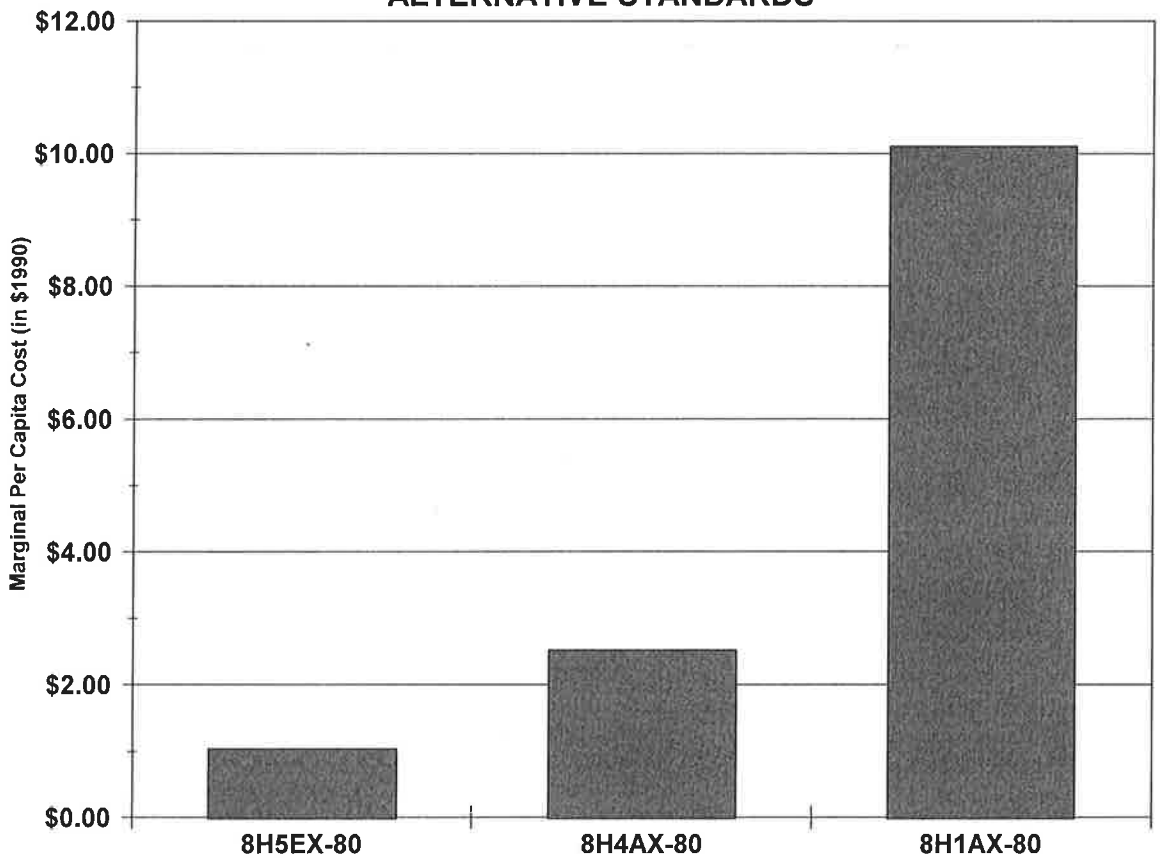


GTM refers to areas in categories "Greater Than Marginal"

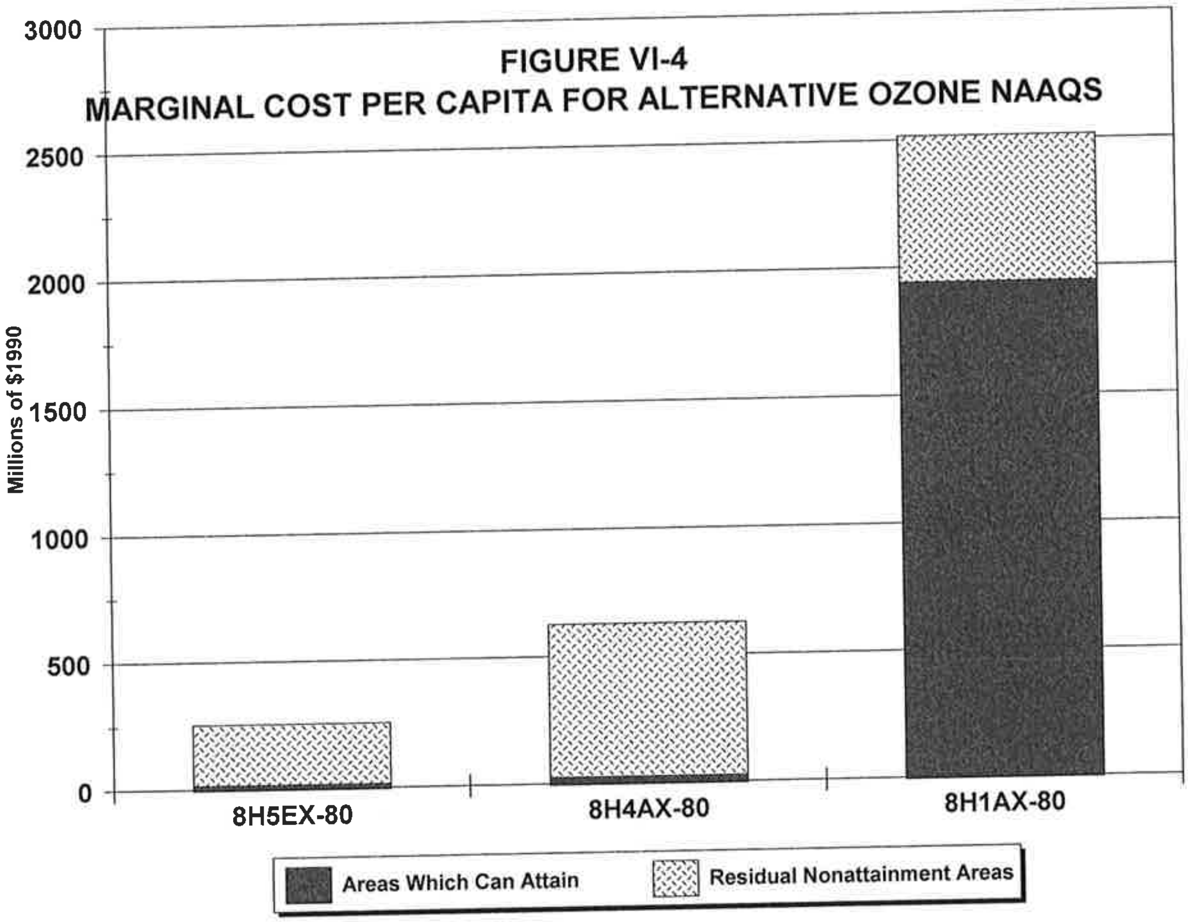
strategy - nothing more. It does not represent the marginal cost of going from the 8H4AX-80 standard to the 8H1AX-80 standard because in each case, the area remains nonattainment but represents different partial attainment air quality, different effected populations, and different geographic areas.

If no single metric will work to compare alternative standards, perhaps the limited usefulness of a number of different comparisons can combine to tell a reasonable story. Given the above caveats, Figure VI-1 shows the relative number of counties in different nonattainment classifications. Figure VI-2 displays the distribution of populations between marginal and worse-than-marginal nonattainment classifications under the three alternatives. The values are presented in millions of persons. Figure VI-3 displays the relative cost for available control measures for each alternative. The values are presented in millions of 1990 dollars. Figure VI-4 displays the relative cost per capita for each alternative, in 1990 dollars.

FIGURE VI-3
THE MARGINAL COST OF AVAILABLE CONTROL MEASURES TO ATTAIN ALTERNATIVE STANDARDS



Within the limitations of comparison listed above, of the alternative eight hour primary ozone standards analyzed by this RIA, the 8H5EX-80 standard ranks as least restrictive in terms of number of nonattainment areas (thirty one), size of nonattainment areas (167 counties), and marginal cost of reaching VOC and NOx targets ($255 million).[1] It also has the smallest population in residual nonattainment (46 million people). The standard is also the least costly on a per capita basis, with an expected annual per capita cost of about one dollar more than that of the current standard. The 8H5EX-80 standard has the smallest amount of residual nonattainment, with intractable areas clustered primarily in those areas which one would most expect persistent nonattainment to exist: Southern California and along the Ozone Transport Corridor between Northern Virginia and New Hampshire.



1 This is the cost of available measures, without estimating the cost of residual nonattainment.

The 8H4AX-80 standard ranks next in terms of marginal cost ($626 million), number of nonattainment areas (37), and the number of counties contained within them (202). The marginal cost of the 8H4AX-80 standard is nearly two and a half times that of the 8H5EX-80 standard. The counties within 8H4AX-80 nonattainment areas represent a twenty percent increase over the 8H5EX-80 form, with residual nonattainment centered on the same geographic areas, but somewhat larger in area than under the 8H5EX-80 form. Almost fifteen percent more people (13 million) would live in nonattainment areas under the 8H4AX-80 standard versus the 8H5EX-80 standard. The per capita cost of control strategies adds an extra three dollars to that of the current standard.

The most restrictive alternative examined by this RIA is the 8H1AX-80 standard, under which 427 counties are designated as part of nonattainment areas, over twice that of the 8H4AX-80 standard. Residual nonattainment is also more pervasive, spreading even further beyond the 8H5EX-80 form's residual nonattainment boundaries. This RIA estimates the marginal control strategy cost for the 8H1AX-80 standard to be $2.5 billion, over four and a half times that of the 8H4AX-80 standard. Per capita, the 8H1AX-80 standard does no better, increasing the per capita cost of the current standard by about $10 per year.

VI(D) CONCLUSIONS OF THE REGIONAL CONTROL SCENARIO ANALYSIS

In terms of area affected, populations affected, costs, and the pervasiveness of residual nonattainment, the 8H5EX-80 form of the standard has the least measurable impact beyond that associated with not changing the current standard. Under the above ranking criteria, the 8H4AX-80 ozone standard ranks second and the 8H1AX-80 form ranks last. The proposed standard falls somewhere between the 8H4AX-80 and the 8H1AX-80 forms in terms of costs, number of affected counties, number of nonattainment areas, and the number of residual nonattainment areas. However, given the caveats associated with this RIA's analytical methodology, its inventories, and its inability to resolve the residual nonattainment problem, the relative ranking of alternatives cannot be considered conclusive.

VI(E) EMISSION REDUCTIONS AND COSTS UNDER THE LOCAL CONTROL SCENARIO

For purposes of completeness, the staff performed a sensitivity analysis assuming current regional efforts are not successful and only local controls may be used to address ozone problems. The LCS baseline, therefore, includes the full implementation of current CAA requirements for reductions and projected emissions growth by SIC code in accordance with the methodologies described in Chapter IV of this RIA. The following sections of this chapter perform the same analyses discussed above - only without the application of a regional control strategy in the ROM domain. For the West, nonattainment areas and targets are the same as those employed in the RCS baseline analysis. The costs, number of counties, number of nonattainment and residual nonattainment areas for each alternative under this LCS analysis indicate the same relative ranking as that shown for the baseline analysis. In addition, the costs, populations, and nonattainment area counts for each alternative are higher under the LCS than under their respective RCS analyses.

VI(E)(1) SUMMARY OF TOTAL EMISSION REDUCTIONS AND CONTROL COSTS BY NONATTAINMENT AREA

Based upon the control strategy selection process described in Chapter V, Section D, the staff observed the following cost impacts on the three alternative ozone primary standards when performing its sensitivity analysis based upon an ozone concentration baseline that does not include the include a regional control scenario in the East. Counterintuitive results (e.g., reductions in tons reduced under stricter standards) are an artifact of the process through which nonattainment areas are identified and should not be considered errors.

VI(E)(1)(a) THE CURRENT STANDARD (1H1EX-120) AND THE 8H2AX-90 ALTERNATIVE

The 1H1EX-120 and the 8H2AX-90 forms of the standard are analytically the same. The remainder of this discussion will refer only to the 1H1EX-120 form with the clear understanding that the discussion applies equally to both forms. The staff identified sixty five modeled nonattainment counties in the year 2007 for the current 1H1EX-120 standard under the LCS. When these nonattainment counties were assigned to nonattainment areas in accordance with current part 51 implementation practices, it identified 141 additional counties, for a total of 206 counties in twenty seven nonattainment areas. Seventeen of the twenty seven nonattainment areas had a maximum expected ozone concentration of less than 138 ppm. Of the ten remaining nonattaiment areas which would be required to implement VOC or NOx control strategies to attain the current standard, three were in California and the remainder were in the ROM domain. Of the ten, only Beaumont had sufficient measures to attain the current standard. No area fell within the seventy five percent "range of uncertainty", so the staff identified all nine remaining areas as in residual nonattainment. Table IV-5 lists the costs associated with attainment strategies for the current standard under the LCS. Appendix A, Table A-5 lists the counties within each of the current standard nonattainment areas under the LCS.

TABLE VI-5
Supplemental Analysis:
Total Costs for the Current (1H1EX-120) and 8H2AX-90
Standards In the Year 2007 Under the LCS

Area	VOC Cost *	NOx Cost *	TOTAL COST*	Area	VOC Cost *	NOx Cost *	TOTAL COST*
Bakersfield	$7.9	$0.0	$7.9	Los Angeles	$265.7	$0.0	$265.7
Baton Rouge	$33.7	$2.0	$35.8	New London	$7.2	$7.0	$14.2
Beaumont	$193.4	$0.0	$193.4	New York	$359.5	$278.0	$637.5
Boston	$21.8	$305.3	$327.1	Philadelphia	$252.3	$98.1	$350.5
Houston	$437.1	$13.8	$450.9	San Diego	$43.9	$0.0	$43.9
				TOTALS	**$1,622.5**	**$704.3**	**$2,326.8**

* In Millions of 1990 dollars
Shaded area indicates where the available VOC and NOx control measures were considered sufficient to attain the standard, asterisks indicate areas within the range of uncertainty which could potentially attain while achieving less than 100% of their targeted reductions.

The VOC and NOx targets established to attain the current standard under the LCS scenario result in an expected reduction of approximately 182 thousand tons of NOx per year and 578 thousand tons of VOC. NOx reductions will cost an expected $700 million annually. VOC reductions will cost another $1.6 billion, for a total baseline cost to achieve the current standard of $2.3 billion per year, or about $9 per year per capita, almost twice the per capita cost associated than with the current standard under the RCS.

VI(E)(1)(b) ALTERNATIVE 8H5EX-80

The staff identified 166 modeled nonattainment counties in the year 2007 for the 8H5EX-80 standard. Assigning these nonattainment counties to nonattainment areas resulted in a total of 374 nonattainment counties in fifty seven nonattainment areas. Thirty five of the fifty seven nonattainment areas had a maximum estimated ozone concentration of less than 92 ppm. Of the remaining twenty two nonattainment areas, seventeen were in the ROM domain, the other five were in California. Table VI-6 lists the marginal cost in nonattainment areas for which VOC or NOx controls would be required. Appendix B, Table B-6 lists the counties within each of the 8H5EX-80 standard nonattainment areas under the LCS. Three nonattainment areas could achieve their targets for the 8H5EX-80 standard. Two more areas came within twenty five percent of their VOC or NOx targets and the technical team determined they were probably able to attain the 8H5EX-80 standard. The other seventeen nonattainment areas were identified as having residual nonattainment.

The VOC and NOx controls in Table VI-6 result in an expected reduction of approximately 100 thousand tons of NOx per year and 350 thousand tons of VOC per year beyond that which is required to meet the current standard. Marginal NOx reductions carry an expected marginal cost of $1.2 billion annually. VOC reductions will have an expected marginal cost of $322 million, for a total marginal cost to achieve the 8H5EX-80 standard under the LCS of $1.5 billion per year. On a per capita basis, the staff expects the marginal cost per person per year for the 8H5EX-80 standard under the LCS to be about $6, an increase in marginal per capita costs over the 8H5EX-80 alternative under an RCS of approximately six times. These impacts are fully discussed in Chapter VII “Economic Assessment”.

TABLE VI-6
Supplemental Analysis:
Marginal Costs for the 8H5EX-80 Standard In the Year 2007
Under the LCS

Area	VOC Cost *	NOx Cost *	TOTAL COST*	Area	VOC Cost *	NOx Cost *	TOTAL COST*
Athens, GA	$4.6	$6.6	$11.2	Macon, GA *	$10.2	$122.4	$132.6
Atlanta, GA	$98.1	$408.6	$506.7	Nashville, TN	$25.9	$84.0	$109.9
Bakersfield, CA	$0.0	$0.0	$0.0	New London, CT	$0.0	$0.0	$0.0
Baton Rouge, LA	$0.0	$0.0	$0.0	New York, NY	$0.0	$0.0	$0.0
Beaumont, TX	($193.4)	$0.0	($193.4)	Owensboro, KY	$1.9	$29.4	$31.3
Boston, MA	$21.8	$305.2	$327.0	Philadelphia, PA	$0.0	$0.0	$0.0
Cincinnati, OH *	$50.3	($265.0)	($214.7)	Providence, RI	$26.5	$18.6	$45.0
Fresno, CA	$19.3	$0.2	$19.4	Sacramento, CA	$22.2	$0.0	$22.2
Grand Rapids, MI	$78.6	$20.1	$98.7	San Diego, CA	$0.0	$0.0	$0.0
Hartford, CT	$25.0	$23.8	$48.8	Springfield, MA	$2.5	$30.9	$33.4
Houston, TX	$7.1	$1.1	$8.2	Washington D.C.	$121.6	$440.5	$562.1
Los Angeles, CA	$0.0	$0.0	$0.0	**TOTALS**	**$322.2**	**$1,226.3**	**$1,548.4**

* In Millions of 1990 dollars
Shaded area indicates where the available VOC and NOx control measures were considered sufficient to attain the standard, asterisks indicate areas within the range of uncertainty which could potentially attain while achieving less than 100% of their targeted reductions.

VI(E)(1)(c) ALTERNATIVE 8H4AX-80

The staff identified 207 modeled nonattainment counties in the year 2007 for the 8H4AX-80 standard under the LCS. Assigning these nonattainment counties to nonattainment areas added 225 more counties, for a total of 432 nonattainment counties in sixty eight nonattainment areas. Fifty three of the identified nonattainment areas were in the ROM domain. Nine areas were in California and three areas were located in NRNC areas. Thirty eight of the sixty eight nonattainment areas had a maximum estimated ozone concentration of less than 92 ppm. Of the remaining thirty nonattainment areas, twenty one were in the ROM domain, seven were in California, and one was in the NRNC domain. Table VI-7 lists the marginal costs for nonattainment areas for which VOC or NOx controls would be required. Appendix A, Table A-7

TABLE VI-7
Supplemental Analysis:
Marginal Costs for the 8H4AX-80 Standard In the Year 2007 Under the LCS

Area	VOC Cost *	NOx Cost *	Total Cost *	Area	VOC Cost *	NOx Cost *	Total Cost *
Athens, GA	$4.6	$6.6	$11.2	Los Angeles, CA	$0.0	$0.0	$0.0
Atlanta, GA	$98.1	$408.6	$506.7	Macon, GA *	$10.6	$123.1	$133.7
Bakersfield, CA	$0.0	$0.0	$0.0	Modesto, CA	$7.0	$0.0	$7.0
Bangor, ME *	$4.8	$16.0	$20.8	Nashville, TN *	$25.9	$84.8	$110.7
Baton Rouge, LA	$0.0	$0.0	$0.0	New London, CT	$0.0	$0.0	$0.0
Beaumont, TX	$0.0	$0.0	$0.0	New York, NY	$0.0	$0.0	$0.0
Boston, MA	$0.0	$0.0	$0.0	Owensboro, KY	$3.1	$52.1	$55.1
Chicago, IL	$293.8	$81.2	$375.0	Philadelphia, PA	$0.0	$0.0	$0.0
Cincinnati, OH *	$72.1	$40.3	$112.4	Portland, OR *	$40.9	$2.9	$43.9
Dallas, TX *	$195.5	$97.0	$292.6	Providence, RI	$26.5	$18.6	$45.0
Fresno, CA	$19.3	$0.2	$19.4	Sacramento, CA	$22.2	$0.0	$22.2
Grand Rapids, MI *	$80.6	$20.1	$100.7	San Diego, CA	$0.0	$0.0	$0.0
Hartford, CT	$25.0	$23.8	$48.8	Springfield, MA	$2.5	$30.9	$33.4
Houston, TX	$7.1	$3.6	$10.7	Visalia, CA	$3.8	$0.0	$3.8
Huntington, WV	$22.9	$7.5	$30.4	Washington, D.C.	$121.6	$142.1	$263.8
				TOTALS	**$1,087.9**	**$1,159.3**	**$2,247.2**

* In Millions of 1990 dollars
Shaded area indicates where the available VOC and NOx control measures were considered sufficient to attain the standard, asterisks indicate areas within the range of uncertainty which could potentially attain while achieving less than 100% of their targeted reductions.

lists the counties within each of the 8H4AX-80 nonattainment areas under the LCS.

Three nonattainment areas could reach their targets. Six other nonattainment area had sufficient reductions available to reach at least seventy five percent of their VOC and NOx target. The staff identified the remaining twenty one nonattainment areas as having residual nonattainment. The VOC and NOx targets found in Table VI-7 result in an expected reduction of approximately 450 thousand tons of NOx per year and 400 thousand tons of VOC per year beyond the reductions necessary for the current standard. Marginal NOx reductions to attain the 8H4AX-80 standard have an expected marginal cost of $1.4 billion annually. VOC reductions will have an expected marginal cost of $1.1 billion, for a total marginal cost to achieve the 8H4AX-80 standard of $2.5 billion per year. The staff expects the LCS scenario per capita marginal cost to attain the 8H4AX-80 standard will be about $10, or four times greater than the marginal per capita cost of the 8H4AX-80 standard under the RCS.

TABLE VI-8

Marginal Costs for the 8H1AX-80 and 8H4AX-70 Standards In the Year 2007 Under the LCS

	VOC	NOx	Total		VOC	NOx	Total
Allentown, PA	$10.6	$10.2	$20.8	Louisville, KY	$97.3	$27.7	$124.9
Athens, GA	$4.2	$6.0	$10.2	Macon, GA	$13.0	$129.7	$142.7
Atlanta, GA	$103.8	$417.6	$521.4	Memphis, TN *	$60.3	$116.9	$177.2
Augusta, GA	$13.8	$89.3	$103.1	Milwaukee, WI	$46.7	$33.2	$79.9
Austin, TX	$6.3	$3.7	$10.0	Mobile, AL	$45.2	$2.1	$47.2
Bakersfield, CA	$0.0	$0.0	$0.0	Modesto, CA	$7.0	$0.0	$7.0
Bangor, ME	$5.3	$26.3	$31.6	Nashville, TN	$29.9	$95.2	$125.2
Barnstable, MA *	$0.7	$25.3	$26.0	New London, CT	$0.0	$0.0	$0.0
Baton Rouge, LA	$0.7	$0.2	$0.9	New Orleans, LA	$50.5	$7.0	$57.5
Beaumont, TX	$0.0	$0.0	$0.0	New York, NY	$8.1	$6.9	$15.0
Birmingham, AL	$24.8	$181.0	$205.7	Norfolk, VA *	$14.8	$138.0	$152.8
Boston, MA	$0.0	$0.0	$0.0	Owensboro, KY *	$3.1	$52.4	$55.5
Charlotte, NC	$31.4	$191.8	$223.2	Philadelphia, PA	$0.0	$0.0	$0.0
Chattanooga, TN	$19.0	$37.2	$56.3	Phoenix, AZ	$54.3	$2.4	$56.7
Chicago, IL	$293.8	$81.2	$375.0	Pittsburgh, PA	$39.2	$49.3	$88.6
Cincinnati, OH *	$99.6	$43.4	$143.0	Portland, ME	$1.1	$32.4	$33.5
Columbia, SC	$13.0	$92.0	$105.0	Portland, OR	$41.7	$3.5	$45.2
Columbus, OH	$11.5	$6.6	$18.1	Providence, RI	$26.5	$18.6	$45.0
Dallas, TX *	$205.0	$21.2	$226.2	Raleigh, NC *	$26.4	$121.7	$148.1
Dayton, OH	$21.2	$0.9	$22.1	Redding, PA	$4.7	$1.7	$6.4
Detroit, MI	$190.0	$109.4	$299.5	Redding, CA	$24.1	$5.8	$29.9
Dover, DE	$9.9	$11.1	$21.0	Reno, NV	$6.3	$0.2	$6.5
Eugene, OR	$3.1	$1.9	$5.0	Richmond, VA	$15.6	$109.4	$125.0
Evansville, IN	$3.0	$1.5	$4.4	Rochester, NY *	$107.9	$22.6	$130.5
Fresno, CA	$22.6	$0.6	$23.2	Sacramento, CA	$23.2	$0.7	$23.9
Gadsden, AL	$5.4	$17.1	$22.5	St. Louis, MO *	$252.5	$61.3	$313.7
Grand Rapids, MI	$91.4	$24.9	$116.2	San Diego, CA	$0.0	$0.0	$0.0
Green Bay, WI	$23.4	$8.0	$31.5	Santa Barbara, CA	$4.1	$0.2	$4.3
Greensboro, NC	$34.0	$127.3	$161.2	Seattle, WA	$93.3	$80.4	$173.7
Harrisburg, PA	$9.8	$12.7	$22.5	Sherman, TX	$0.9	$0.7	$1.6
Hartford, CT	$25.0	$23.8	$48.8	Shreveport, LA	$10.0	$1.8	$11.7
Houston, TX	$15.1	$1.9	$17.0	Springfield, MA	$2.5	$30.9	$33.4
Huntington, WV	$32.7	$13.0	$45.6	State College, PA	$4.7	$0.5	$5.2
Indianapolis, IN	$18.2	$7.0	$25.2	Stockton, CA	$6.8	$0.0	$6.8
Johnson City, TN *	$18.4	$288.5	$307.0	Tulsa, OK	$8.2	$1.1	$9.3
Knoxville, TN	$43.9	$95.8	$139.7	Visalia, CA	$4.2	$0.0	$4.2
Los Angeles, CA	$0.0	$0.0	$0.0	Washington, D.C.	$134.1	$450.5	$584.6
				York, PA	$9.0	$7.2	$16.2
				TOTALS	**$2,687.2**	**$3,590.3**	**$6,277.6**

* In Millions of 1990 dollars

Shaded area indicates where the available VOC and NOx control measures were considered sufficient to attain the standard, asterisks indicate areas within the range of uncertainty which could potentially attain while achieving less than 100% of their targeted reductions.

VI(E)(1)(d) ALTERNATIVES 8H1AX-80 AND 8H4AX-70

The 8H1AX-80 and the 8H4AX-70 forms of the standard are analytically the same. The remainder of this discussion will refer only to the 8H1AX-80 form with the clear understanding that the discussion applies equally to both forms. The staff identified 581 modeled nonattainment counties in the year 2007 for the 8H1AX-80 standard under the LCS, based on all current CAAA requirements being fully met and all possible efforts have been undertaken to meet the current standard. When these nonattainment counties were assigned to nonattainment areas in accordance with current part 51 implementation practices, 218 counties were added, for a total of 799 nonattainment counties in 129 nonattainment areas. Fifty four of the 129 nonattainment areas had a maximum estimated ozone concentration of less than 92 ppm. Of the remaining seventy five nonattainment areas, sixty were in the ROM domain, ten were in California, and five were in the NRNC domain. Table VI-8 lists the marginal costs associated with the nonattainment areas for which VOC or NOx controls would be required. Appendix A, Table A-8 lists the counties within each of 8H1AX-80 nonattainment areas. Based upon their expected reductions, seventeen nonattainment areas had sufficient measures available in their inventories to reach their targets. Another twelve nonattainment areas were able to attain at least seventy five percent of their targets and the staff identified them as areas probably able to reach attainment. The remaining forty six nonattainment areas have predicted residual nonattainment.

The VOC and NOx targets incorporated in Table VI-8 result in an expected reduction of approximately 1.1 million additional tons of NOx per year beyond those necessary to attain the current standard, and 1.2 million tons of VOC per year. NOx reductions above and beyond CAAA requirements and those measures necessary to attain the current standard will have a marginal cost of about $3.6 billion annually. VOC reductions will have an expected marginal cost of $2.7 billion, for a total marginal cost to achieve the 8H1AX-80 standard of $6.3 billion per year. Per capita, the marginal cost of attaining the 8H1AX-80 standard under a local control strategy scenario, is about $25, an increase in marginal per capita costs over the 8H1AX-80 standard with a regional strategy in the East of 250%.

VI(F) CONCLUSIONS OF THE LOCAL CONTROL SCENARIO ANALYSIS

The results of the LCS analysis parallel those of the analysis performed for the baseline. In terms of area affected, populations affected, costs, and the number of residual nonattainment areas, the 8H5EX-80 form of the standard is again the least restrictive eight hour alternative. The 8H4AX-80 ozone standard ranks second and the 8H1AX-80 form ranks last. However, the caveats relating to methodology, inventories, and residual nonattainment still apply, reducing the degree of reliability which can be placed upon any conclusions reached. However, the LCS analysis provides a framework for one important consideration: The LCS analyses illustrates the need for greater flexibility within the ozone implementation process.

Clearly, for many areas, the problem is not one of not doing enough, but not being able to do much of anything at all. For example, Los Angeles requires VOC reductions on the order of seventy five to ninety percent, while available control measures account for less than ten percent. In areas of persistent nonattainment, further reliance upon command-and-control measures results in the application of additional add-on controls which are generally not cost effective. In areas of residual nonattainment, there are simply no more controls to apply under the restricted implementation scheme we used for this analysis. Under subpart (2), only counties within the nonattainment area can participate in an attainment strategy. For instance, the ozone level in York, Maine determined the Boston C/MSA's design value for all six alternative standards under the LCS. However, for three of the alternatives examined, York was the only county which recorded an ozone concentration greater than the marginal nonattainment level cut-off. In all alternatives, at least seventy five percent of the counties in the Boston C/MSA had ozone concentrations below the level of the standard. Because of the violation in York, all twelve counties in the Boston nonattainment area must, according to subpart (2), participate in strategies to reduce VOC and NOx emissions, regardless of their relative contribution to the solution. Given the relatively low number of counties which actually record a violation for many nonattainment areas, the application of a regional strategy that transcends nonattainment area boundaries may reduce the ozone concentrations to such an extent that many of these areas would not become nonattainment areas in the first place. Then, with the imposition of additional flexibility, such as more meaningful definitions of nonattainment areas, the ability to take credit for upwind control, and market based mechanisms, the level of residual nonattainment may be reduced to the two or three historic areas where the ozone problem is the worst: i.e., Southern California, the Gulf Coast, and the North Atlantic Coast.

Much of this flexibility is planned for the part 51 integrated implementation analysis when the Agency investigates the applicability of trading schemes, alternative definitions of nonattainment area size and designation, long range transport issues, the applicability of intermittent voluntary controls, and jointness in control between ozone and PM. However, the analytical baseline includes some regional NOx management through the incorporation of an OTAG-wide NOx cap and LEV program. A detailed discussion of this baseline is included in Chapter IV of this RIA.

In terms of area affected, populations affected, costs, and the pervasiveness of residual nonattainment, the 8H5EX-80 form of the standard has the least measurable impact beyond that associated with not changing the current standard. Under the above ranking criteria, the proposed ozone standard ranks second and the 8H1AX-80 form ranks last. However, given the caveats associated with this RIA's analytical methodology, its inventories, and its inability to resolve the residual nonattainment problem, the relative ranking of alternatives cannot be considered conclusive

VI(G) RESIDUAL NONATTAINMENT

Tables VI-9 and VI-10 display the tons of VOC and NOx reductions necessary to fully attain each alternative standard, incremental to the full attainment of the current standard. Table VI-9 represents the RCS and Table VI-10 presents information on the LCS. Estimating the cost associated with additional emission reductions needed to eliminate residual nonattainment is a difficult task, given that this analysis is not able to identify specific controls to achieve these reductions by 2007. The implication of residual nonattainment is that areas with a VOC or NOx deficit need more time; new control strategies (e.g., regional controls or economic incentive programs); and/or new technologies in order to attain the standard. However, some indication of the nature of the residual nonattainment problem is presented in this analysis for the purpose of completeness.

TABLE VI-9
ESTIMATIONS OF THE NATURE THE OF RESIDUAL NONATTAINMENT PROBLEM FOR ALTERNATIVE[1] STANDARDS UNDER THE RCS

STANDARD	VOC (tpy)[2 3]	NOx (tpy)[2 3]
Current Standard[4]	370 - 562	0
Incremental from the current standard:		
8H5EX-80[1]	11 - 17	13 - 19
8H4AX-80[2]	102 - 155	17 - 25
8H1AX-80[2]	422 - 642	73 - 111

1 Alternative standard values are incremental to the full attainment of the current standard.
2. In thousands of tons.
3. Numbers represent low - high range values, with the point estimate above and without parentheses.
4. The current standard is assumed to be approximately equal to an 8-hour, .09 ppm, 2AX alternative.

The marginal cost associated with the most expensive current control approaches might be a starting point for evaluating residual nonattainment. For example, this RIA has performed a detailed analysis of a few sample cities in terms of the marginal cost of controls. The cost of the most expensive controls used in the model range between $30,000 and $80,000 per ton. It has been suggested that these may appropriately reflect the marginal cost (on top of identified controls) to achieve emission reductions necessary to attain a more stringent standard. Although such costs could be applied to the VOC or NOx deficits, the Agency does not view these cost estimates as the most appropriate range to apply to the emission reduction deficits; the Agency believes lower costs are more appropriate. This assertion is based in part on historic evidence associated with the cost of emission controls which indicates that, instead of spending extremely high costs to achieve each ton of reduction, sources have demonstrated an ability to adopt economic incentive programs such as RECLAIM in Los Angeles or develop innovative strategies and new technologies for NOx and VOC emission controls. Second, some areas have been given additional time to attain the standard. Also, imposing additional local controls for some areas may be less effective than improving regional controls.

The Agency has prepared a number of analyses from which cost estimates are available. A range of $2,000 to $10,000 per ton has been identified for estimating the cost associated with each ton of VOC or NOx deficit. The range was estimated by the Agency as the average incremental cost per ton to achieve the current 0.12 ppm 1-hour NAAQS for achieving the 1990 CAAA requirements. Also, $10,000 per ton is a point estimate used in the California Federal Implementation Plan (FIP) analysis. $5,000 per ton (the average result of the 812(a) draft report) could be used as a point estimate of the cost of these additional emission reductions. Based on these cost estimates, the Agency believes this range is appropriate for estimating the cost of residual nonattainment.

However, it should be noted that uncertainties are associated with the cost range presented above. The range is used to represent the average cost of reducing each ton of VOC or NOx and therefore treats the cost of reducing each ton as equal. An average cost estimate does not differentiate between lower and higher marginal costs of these additional emission reductions. Within the relevant range of this analysis, the marginal cost of achieving each additional unit of emission reduction is higher than the marginal cost of achieving the previous unit. Resource limitations prevent a treatment of these emission reductions in a marginal approach. Therefore, the average cost per ton approach is preferred.

TABLE VI-10
ESTIMATIONS OF THE NATURE OF THE RESIDUAL NONATTAINMENT PROBLEM FOR ALTERNATIVE STANDARDS UNDER THE LCS[1]

STANDARD	VOC (tpy)[2 3]	NOx (tpy)[2 3]
Current Standard[4]	506 - 770	8 - 13
Incremental from the Current Standard:		
8H5EX-80	100 - 150	20 - 30
8H4AX-80	190 - 290	40 - 50
8H1AX-80	520 - 780	120 - 180

1 This scenario represents an unlikely air quality baseline for the year 2007. The reader should refer to the regional control scenario for a better estimate of the likely baseline.
2. In thousands of tons.
3. Numbers represent low - high range values, with the point estimate above and without parentheses.
4. The current standard is assumed to be approximately equal to an 8-hour, .09 ppm, 2AX alternative.

VI(H) REFERENCES

EPA, 1990: The United States Environmental Protection Agency, Office of Air Quality Planning and Standards, "Regulatory Impact Analysis for the Proposed South Coast District Federal Implementation Plan" July, 1990.

EPA, 1996a: The United States Environmental Protection Agency, Office of Air Quality Planning and Standards, "Review of National Ambient Air Quality Standards for Ozone Assessment of Scientific and Technical Information, OAQPS Staff Paper," June, 1996.

EPA, 1996b: The United States Environmental Protection Agency, Office of Air Quality Planning and Standards, "National Low Emissions Vehicle Regulatory Impact Analysis" 1996.

EPA, 1996c: The United States Environmental Protection Agency, Office of Air Quality Planning and Standards, "Clean Air Power Initiative White Paper", 1996.

CHAPTER VII SUMMARY OF POTENTIALLY AFFECTED ENTITIES

This chapter briefly summarizes the control measures, economic sectors, and Standard Industrial Classification (SIC) codes potentially affected by the control measures considered in the ozone NAAQS review. The control measures cover stationary (point and area) and mobile (on-highway and nonroad) sources of VOC and NOx emissions. The Agency prepared the emission reduction and control cost analyses to support the ozone NAAQS review. The analyses compared the incremental impacts of three NAAQS alternatives to the current standard. To analyze the impacts associated with each of the NAAQS alternatives relative to the current standard, the Agency developed control measures as surrogates for control measures that State or local agencies may potentially use in their State Implementation Plans (SIPs) to attain each of the NAAQS alternatives. This chapter refers to surrogate control measures as incremental measures. Appendix C, Table C-1 shows the incremental control measures and potentially affected source categories for stationary and mobile sources of VOC and NOx emissions.

This chapter limits the discussion of control measures to those selected during the least-cost control analysis of each alternative. Therefore, for some control measures, several control techniques were considered but not selected because they were not the most cost-effective technique for achieving the emission reductions needed. Consequently, not all available control techniques for a control measure are identified in the following discussion. References at the end of this chapter provide information about the sources used in the ERCAM to estimate control costs using data contained in the Interim 1990 Inventory.

VII(A) STATIONARY POINT SOURCES

The Interim 1990 Inventory generally includes point source facilities that emit 100 tons per year or more of one of the criteria air pollutants, along with SIC codes for most of the associated facilities. For each of the incremental control measures, the Agency used ERCAM to identify all of the potentially affected facilities and their SIC codes. The SIC codes and sectors potentially affected by the incremental VOC and NOx control measures for stationary point sources can be found in Appendix C, Tables C-2 and C-3, respectively.

VII(A)(1) VOC CONTROL MEASURES

The incremental control measures for point sources of VOC emissions include industrial, wood product, and metal product surface coating; rule effectiveness improvements; and incineration/open burning. The industrial surface coating operations incremental control measure utilizes add-on control equipment to achieve VOC emission reductions beyond those achieved by Maximum Achievable Control Technology (MACT) standards (Pechan, 1994a). This control measure was applied to automobile, light-duty truck, and plastic parts surface coating operations. The incremental control measure for wood products surface coating operations applies the VOC limits for wood products surface coating operations contained in the ozone Federal Implementation Plan (FIP) for California, based on the use of reformulated coatings and/or improved transfer efficiency of coating application equipment (Pechan, 1994a). The control measure was applied to wood furniture and flatwood products surface coating operations.

The incremental control measure for metal surface coating operations uses reformulated coatings and/or improved transfer efficiency for coating application equipment (Pechan, 1994a), applied to beverage can, metal coil, metal furniture, large appliance, and miscellaneous metal parts surface coating operations. The Agency estimated incremental control costs associated with this control measure to be zero and, therefore, did not analyze its economic impacts or identify its potentially affected SIC codes.

The point source inventory also contains source classification codes (SCCs) for "general" or "unspecified" surface coating emission sources. SCC descriptions are not explicit about the type of coating operation with which they are associated. Therefore, the Agency relied upon engineering judgment to assign the general and unspecified SCCs to the industrial and other general surface coating categories. The SCCs assigned to the industrial surface coating category cover the following general categories of surface coating emissions: solvent-based paints, lacquers, enamels, adhesives, primers, and thinning solvents. The SCC for general lacquer use was assigned to the wood products surface coating category. This step was necessary to link potentially applicable control measures with the SCCs to estimate emission reductions and control costs. The SIC codes associated with the "general/ unspecified" emission sources assigned to the industrial and wood products surface coating categories did not correspond to the names of specific types of surface coating operations (e.g., automobile, light-duty truck, and plastic parts surface coating operations). Therefore, Appendix C, Table C-2 lists the "general/unspecified" SICs separately from the specific types of coating operations.

The control measure for incineration/open burning requires affected entities to cease open burning activities on days that are predicted to exceed the ozone NAAQS. Burning activities would be shifted to days where emissions would not contribute to the potential for a NAAQS exceedance. The control measure reduces emissions on specific days, but not total annual emissions (Pechan, 1994a). The Agency did not analyze the economic impacts of this control measure or identify its potentially affected SIC codes because it does not increase costs to the affected entities.

Rule effectiveness improvements were applied to simulate the effects of improving the implementation of regulations. A rule effectiveness improvement may take several forms, ranging from more frequent and in-depth training of inspectors and/or plant personnel to increased monitoring, record keeping, and reporting (STAPPA/ALAPCO, 1993). The Interim 1990 Inventory used a default rule effectiveness value of 80 percent in its point source estimates for VOC emissions. The 80 percent default value is based on EPA guidance. In some instances, the Interim 1990 Inventory assumed a rule effectiveness of 100 percent. This analysis assumes emission points with base year control efficiencies of greater than 50 percent will improve their rule effectiveness from 80 to 90 percent, achieved through increased stack monitoring, record keeping, and reporting.

VII(A)(2) NOx CONTROL MEASURES

The incremental control measure for utility boilers uses a post-combustive selective catalytic reduction (SCR) control technique (Pechan, 1994a). The Agency also considered combustion modification techniques [e.g., low-NOx burners (LNB), overfire air (OFA), natural gas reburn (NGR), and flue-gas recirculation (FGR)]. However, the Agency found SCR was the most cost-effective technique for achieving the NOx emission reductions needed from utility boilers. Planned and generic units were used to estimate emissions associated with future growth in utility boiler emissions. For the areas for which costs and emission reductions were estimated under each of the three NAAQS alternatives, the control measure affected natural gas and oil tangentially fired utility boilers in the point source inventory.

Industrial boilers typically produce steam to generate mechanical power or electricity. The incremental control measure applied to coal, oil, and natural gas fired industrial boilers is based on the use of SCR (Pechan, 1994a). As with utility boilers, the Agency also considered combustion modification techniques (e.g., LNB and NGR) and post-combustion control techniques [e.g., selective noncatalytic reduction (SNCR)]; however, SCR was found to be the most cost-effective technique for achieving the NOx emission reductions needed from industrial boilers.

Essentially all NOx emissions from cement manufacturing come from high temperatures generated in cement kilns. The incremental control measure applied to cement kilns is based on the use of SCR (Pechan, 1994a). Glass manufacturing furnaces are a source of NOx emissions. Oxy-firing was the incremental control measure for glass manufacturing furnaces (Pechan, 1994a).

The incremental control measure for natural gas-fired turbines is based on the use of SCR and steam injection combined. For oil-fired turbines, the incremental control measure applies SCR and water injection combined (Pechan, 1994a). For natural gas-fired reciprocating internal combustion (IC) engines, nonselective catalytic reduction (NSCR) is applied as the incremental control measure (Pechan, 1994a).

Process heaters transfer heat to fluids. When steam heat cannot supply sufficient heat, the most common fuels used in process heaters are oil and natural gas. The incremental control measure for natural gas-fired and oil-fired process heaters uses LNB and SCR combined (Pechan, 1994a).

Municipal waste incinerators burn solid waste. Municipal waste incinerator source category include four combustor types: starved air - multi-chamber; mass burn - single chamber; derived fuel; and conical design (tee pee), municipal refuse. The incremental control measure for municipal waste incinerators applies SNCR (Pechan, 1994a).

The incremental VOC control measure previously described for incineration/open burning also achieves NOx emissions reductions and, therefore, was modeled as an incremental NOx control measure.

VII(B) STATIONARY AREA SOURCES

The area source inventory accounts for stationary source emissions not included in the point source inventory. Appendix C, Tables C-4 and C-5 show the SIC codes and sectors potentially affected by the area source incremental control measures for VOC and NOx. The Standard Industrial Classification Manual 1987 was used to identify the SIC codes potentially affected by the NOx control measures for residential natural gas consumption (i.e., water and space heaters). For the VOC control measures, the Standard Industrial Classification Manual 1987 and the documentation of area source category codes for the Aerometric Information and Retrieval System (AIRS) Area and Mobile Subsystem (AMS) were used to identify the potentially affected SIC codes for each control measure (EPA, 1993). The area source category codes used in the Interim 1990 Inventory are the same as those used in AIRS/AMS.

As with the NOx control measures for industrial boilers in the point source inventory, the NOx control measures for the area source industrial fuel combustion (i.e., coal, oil, and natural gas) categories have the potential to affect a variety of SIC codes. The area source inventory and the AIRS/AMS documentation do not provide any information on the SIC codes associated with the source category codes for the area source industrial fuel combustion categories. The NOx control measures for area source industrial fuel combustion are based on the extension of point source control measures to obtain emission reductions from the area source component of the Interim 1990 Inventory. Costs for these area source control measures were estimated for establishments that emit from 25 to 100 tons per year of VOC or NOx. Therefore, the National Emissions Inventory (NEI) was used to identify SIC codes potentially affected by these control measures. [1] The SCCs affected by the corresponding point source control measures were used to identify plants in the NEI with uncontrolled NOx emissions between 25 and 100 tons per year. The SIC codes associated with the plants identified were then selected for the RIA and small business impact analysis.

VII(B)(1) VOC CONTROL MEASURES

The incremental control measure for controlling VOC emissions from retail gasoline service stations is based on the installation of pressure vacuum (PV) valves on the vent lines of underground storage tanks plus Stage I RACT guidelines. Under Stage I requirements, tank truck operators must recover gasoline vapors displaced in storage tanks when they are filled with gasoline (Pechan, 1994a). The Stage I requirements would directly affect entities that transport gasoline from bulk plants and terminals to gasoline service stations [i.e., SIC code 517 (Petroleum and Petroleum Products Wholesalers)]; however, the Stage I vapor recovery requirements offset the costs associated with the installation and use of the vapor recovery equipment.

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1 The NEI was developed by EPA in 1995 and 1996 to support improvements to photochemical grid modeling of ozone precursors. The NEI contains 1990 base year emission inventories supplied by the States, which previously had not been included in the Interim 1990 Inventory. The NEI was used for this analysis because many States provided data for a significant number of plants that emit less than 100 tons per year of VOC and NOx.

RACT formed the basis for the control measure for bulk terminals in ozone nonattainment areas, based on the use of submerged fill and vapor recovery or other control systems to achieve a recommended emission limit of 80 mg/liter (0.67 lb/1,000 gal). Mandatory leak detection and repair programs are required to prevent leaks in the vapor collection system (Pechan, 1989). This control measure would potentially affect SIC code 517 (Petroleum and Petroleum Wholesalers).

The industrial surface coating control measure is based on the use of add-on control equipment to achieve VOC emission reductions beyond those achieved by MACT standards (Pechan, 1994a). This control measure is applied to paper, aircraft, and marine surface coating operations in the area source inventory. The incremental control measures for metal product, flatwood product, and wood furniture surface coating operations use reformulated coatings and/or improve the transfer efficiency of coating application equipment (Pechan, 1994a). Miscellaneous surface coating operations use low-VOC coatings to achieve emission reductions equivalent to those achieved by MACT standards, or apply add-on controls to achieve VOC reductions beyond those achieved by MACT standards (Pechan, 1994a). Table C-4 presents the SIC codes that would potentially be affected by these control measures.

Two control measures affect autobody refinishing operations: Option 1 is based on low-VOC coating limits identical to the California's Best Available Retrofit Control Technology limits, surface preparation product limits, and the use of painting gun cleaners. Option 2 is based on requirements proposed in the California FIP, that would require the use of low-VOC coatings (or an emission control system) and a transfer efficiency equivalent to that achieved through the use of high-volume, low-pressure spray equipment. SIC code 753 (Automotive Repair Shops) could be affected by the two control measures for this source category.

RACT requirements formed the basis for the incremental VOC control measures for cutback asphalt and web offset lithography operations. The Agency estimated the incremental control cost for cutback asphalt operations to be zero. For web offset lithography operations, the incremental control measure uses VOC recovery equipment which results in a net savings rather than a cost (Pechan, 1994a). Because these control measures do not increase costs, the Agency did not analyze them or identify their potentially affected SIC codes.

Adhesives typically consist of a base material plus additives such as diluents, solvents, catalysts, hardeners, inhibitors, and retarders. Manufacturers of industrial adhesives can reduce VOC emissions through product reformulation (i.e., conversion to water-based, diluent-based, and solventless products) and product substitution. The incremental VOC control measure for industrial adhesives involves RACT requirements (Pechan, 1994a). The manufacturers of industrial adhesives (SIC code 289) would potentially be affected by this control measure.

Leak detection and repair (RACT) form the basis for the incremental control measure for fugitive VOC emission leaks from petroleum refineries and synthetic organic chemical manufacturing industry (SOCMI) facilities (Pechan, 1994a). For SOCMI batch reactor processes, the control measure is based on RACT use of condensers, scrubbers, carbon adsorption, thermal destruction, or changing operational practices to control emissions from process vents. The fugitive VOC control measure for oil and natural gas production fields is based on the implementation of an equipment and maintenance program to control emissions from storage tanks and transfer operations (Pechan, 1989).

Table C-4 shows the SIC codes for each source category potentially affected by these control measures.

Aerosol spray paints are a subcategory of consumer and commercial products that include, for example, general flat and enamel paints, hobby paints, automotive exact-match paints, and fluorescent paints. Most aerosol spray paint products consist of the paint resin and pigment (solids) additives, solvents, and propellants. Aerosol paints are used widely by homeowners, industry, commercial operations, and artists and hobbyists. The primary method for decreasing VOC emissions associated with the use of aerosol paint products is through product reformulation to high-solids or water-based paints, reducing the solvent content by changing the resin type, or substituting HFC-152a or compressed air for VOC-based propellant (STAPPA/ALAPCO, 1993). Two incremental control measures for aerosol paints are based on VOC content limits contained in draft rules being prepared by the California Air Resources Board (CARB) and the South Coast Air Quality Management District in California. The CARB's draft Statewide rule establishes two tiers of VOC-content limits on categories of aerosol coating products: the first tier of limits would be effective in 1996 and the second, more stringent tier of limits would be effective in 1999. One of the incremental measures is based on the CARB's Tier II limits. The CARB's Tier II limits are expected to achieve an additional 10 to 15 percent reduction over the Tier I limits which were already included in the base-case CAA scenario. The Tier I limits were estimated to achieve a 20 percent reduction in VOC emissions. The second incremental control measure is based on a draft rule being prepared by the South Coast Air Quality Management District. The limits being considered in the draft rule would achieve an incremental reduction of 40 percent, or 60 percent overall (Pechan, 1994a). These two control measures would potentially affect SIC code 285 (Paints, Varnishes, Lacquers, Enamels, and Allied Products).

The VOC control measure for pesticide application is based on a draft rule prepared by CARB that was also included in the rulemaking for the California ozone FIP. The agency assumed that if the incremental measure is selected for a nonattainment area, it would be applied Statewide. The incremental measure would require producers of agricultural and/or structural pesticides to lower the VOC content of pesticide products by: reducing fumigant usage, alternative application methods, microencapsulation, and integrated pest management programs (STAPPA/ALAPCO, 1993). The control measure would potentially affect SIC code 287 (Agricultural Chemicals).

The incremental control measure for pharmaceutical manufacturing is based on RACT recommendations for installation of surface condensers for reactors, distillation operations, crystallizers, centrifuges, and vacuum dryers that emit 6.8 kg/day (15 lb/day). RACT also recommends the installation of a vapor balance system for emissions associated with the transfer of liquids containing VOC to tanks with a capacity of more than 7,500 liters (2000 gal). In addition, RACT recommends pressure/vacuum vents for liquid storage tanks, covering exposed liquid surfaces (e.g., centrifuges, rotary vacuum filters, and tanks), and the implementation of leak detection and repair programs (Pechan, 1989). SIC code 282 (Drugs) would potentially be affected by this control measure.

The control measure for SOCMI and polymer manufacturing fugitive emission leaks is also based on RACT recommendations for leak detection and repair programs (Pechan, 1989). This control measure would potentially affect SIC code 286 (Industrial Organic Chemicals).

VII(B)(2) NOx CONTROL MEASURES

RACT applies to the incremental NOx control measure for area source industrial coal, oil, and natural gas fuel combustion categories, applied to sources that emit from 25 to 100 tons per year of NOx (Pechan, 1994a). Appendix C, Table C-5 shows the SIC codes identified from the NEI as potentially being affected by the control measures for area source fuel combustion sources. The incremental NOx control measures for residential natural gas consumption are based on the use of LNB for residential water heaters and space heaters, based on an assumed implementation schedule that phases in the use of units equipped with LNB as conventional units reach the end of their useful life (Pechan, 1994a). Manufacturers of residential water heaters and space heaters (SIC codes 363 and 343, respectively) would potentially be affected by these control measures. Because there are no additional costs associated with LNB water heaters, the economic impacts of the control measure on SIC code 363 were not analyzed.

The incremental control measure for open burning was applied to control NOx emissions. The NOx control measure previously discussed for the incineration/open burning point source category also applies for controlling NOx emissions from this area source category (Pechan, 1994a). The economic impacts of this control measure were not analyzed because it does not increase costs to the affected entities. Therefore, the SIC codes potentially affected by the control measure were not identified for this analysis.

VII(C) ON-HIGHWAY MOBILE SOURCES

Light-duty vehicles, light-duty trucks, medium-duty vehicles, and heavy-duty vehicles use a combination of fuel reformulations, new vehicle exhaust emission standards, and enhanced inspection and maintenance (I/M) programs to control VOC and NOx emissions. These measures represent controls that have already been applied in some ozone nonattainment areas, and will be applied as incremental controls in other areas. Each control measure is discussed separately in the following sections. Appendix C, Table C-6 shows the SIC codes and sectors that would potentially be affected by each of the control measures.

VII(C)(1) REFORMULATED GASOLINE

The cost analysis for on-highway vehicles includes control measures based on the Federal reformulated gasoline program and California's program. Reformulated gasoline control measures reduce VOC and NOx emissions from gasoline-powered motor vehicles. The Federal program was required by the CAA to be implemented in 1995 in the nine worst ozone nonattainment areas (EPA, 1992). Additional areas, primarily ozone nonattainment areas within the Northeast Ozone Transport Region (OTR), are included in this program. Emission reductions from the Federal reformulated gasoline program for all areas that utilize this program are included in the base case CAA controls scenario. For other areas, reformulated gasoline is the third control measure applied after application of the enhanced I/M and low emission vehicle (LEV) control measures.

A second control measure is based on the Phase 2 requirements of California's reformulated gasoline program. Phase 2 gasoline must meet specified standards for sulfur, benzene, aromatic hydrocarbons, olefin, Reid vapor pressure (RVP), oxygen, 90 percent distillation temperature, and 50 percent distillation temperature. Phase 2 standards apply to all gasoline powered vehicles in California beginning in 1996 (Pechan, 1994a). California's reformulated gasoline program is applied statewide in California in the base case CAA scenario.

The Federal and California reformulated gasoline control measures will impact refineries that supply gasoline to the areas in which one of these programs is chosen as a least-cost option. Petroleum refineries would incur direct costs caused by increased production costs associated with reformulating gasoline. These costs, if passed on, would potentially affect wholesalers and distributors of reformulated gasoline, gasoline service stations, and consumers.

VII(C)(2) REFORMULATED DIESEL FUEL

The reformulated diesel fuel control measure is designed to reduce NOx emissions by setting limits on the amount of sulfur and aromatics in diesel fuel. The control measure is based on California's reformulated diesel fuel program which affects on-highway and nonroad diesel vehicles. The control measure would affect light-duty, medium-duty, and heavy-duty trucks outside California. California's rule establishes a 500 parts per million sulfur limit as well as a 10 percent limit on aromatics (or 20 percent for small refiners) for its vehicular diesel fuel. The rule contains an equivalency provision that allows refiners to make diesel with more than 10 percent aromatics if engine testing demonstrates equivalent emissions (Pechan, 1994a). The impacts of reformulated diesel fuel program would directly impact refineries, due to the increased production costs required to modify the composition of diesel fuels. These costs, if passed on, would potentially affect wholesalers and distributors of reformulated diesel fuel, gasoline service stations, and consumers.

VII(C)(3) ENHANCED INSPECTION AND MAINTENANCE (I/M)

Enhanced I/M programs test vehicle emissions while the vehicle is idling. Enhanced I/M programs are required in both ozone and carbon monoxide (CO) nonattainment areas, depending upon population and nonattainment classification or design value. Within the OTR, States or areas must implement enhanced I/M programs in any C/MSA or portion of a C/MSA with a 1990 population of 100,000 or more (Pechan, 1994a). The base case includes the effects of I/M programs required under the CAA. For the purposes of this analysis, enhanced I/M programs are used as an incremental control measure in areas where they are not already required by the CAA.

The enhanced I/M program will apply to light-duty vehicles and trucks. The impacts of an I/M program are incurred in terms of inspection fees, and repair costs in the event of test failure. In addition to individual automobile owners, enhanced I/M programs will impact businesses that use specific types of vehicles as the main source of revenue (such as trucking, courier, and taxi companies) and fleet vehicles of non-transport companies (Pechan, 1994b). Decentralized automobile inspection and repair industry will incur any costs associated with establishing emission stations, as well as increased revenue resulting from increased repair activities.

VII(C)(4) LOW EMISSION VEHICLES

Low emission vehicle (LEV) programs establish requirements for phasing-in LEVs into the automobile fleet. In September 1990, the CARB approved a LEV program which includes light and medium-duty motor vehicle emissions standards that progressively reduce emissions from vehicles of model years 1994 through 2003. CARB's regulations establish four new classes of light-duty and medium-duty vehicles with increasingly stringent emission levels: transitional low emission vehicles (TLEVs), LEVs, ultra low emission vehicles (ULEVs), and zero emission vehicles (ZEVs). The California LEV program requires a fleet composition of 75 percent LEVs, 15 percent ULEVs, and 10 percent ZEVs by 2003 (Pechan, 1995).

Since 1990, several States in other areas of the country have adopted the California emission standards. In February 1994, the Northeast Ozone Transport Commission (OTC) States voted to recommend that the EPA mandate the California LEV program in the Northeast OTR, and shortly thereafter presented a petition to EPA. Massachusetts and New York have already enacted legislation for a LEV program. To produce vehicles that meet the standards for LEVs, ULEVs, and ZEVs, automobile manufacturers will be required to add emission controls to engines. The direct impacts of any LEV program will, therefore, be incurred by automobile manufacturers. Depending on the ability of the manufacturers to pass the increased production costs forward, automobile dealerships may also be impacted by the costs of LEV program, as well as automobile consumers.

VII(D) NONROAD MOBILE SOURCES

Incremental control measures for nonroad sources include emission standards for large nonroad compression ignition (diesel) engines and small recreational vehicle spark-ignition (gasoline) engines; emission fees for commercial marine vessels; and reformulated gasoline for nonroad vehicles. Appendix C, Table C-6 shows the SIC codes and sectors potentially affected by each of the control measures.

VII(D)(1) CALIFORNIA STANDARDS FOR ≥175 BHP NONROAD DIESEL ENGINES

This control measure is based on California's NOx standard of 5.8 grams per brake horsepower-hour (g/bhp-hr) for compression ignition engines at or above 175 brake horsepower (bhp). Compression ignition engines at or above 175 bhp are used in logging and construction equipment. Construction equipment using this engine size include excavators, cranes, bore/drill rigs, off-highway tractors, scrapers, rubber tired dozers, and off-highway trucks. Logging equipment with compression ignition engines at or above 175 bhp include machines used to cut and bunch timber. To comply with the California standards, it will be necessary for manufacturers to modify compression ignition engines. The most likely and effective engine modifications include retarding the injection timing, improving fuel pumps and nozzles, and combustion chamber modifications. The impacts of the CARB standards for large, non-road engines are associated with the required variable hardware costs of producing cleaner engines (STAPPA/ALAPCO, 1993; Pechan, 1994a, 1994c).

The direct impacts of this control measure would be incurred by the manufacturers of compression ignition engines for logging and construction equipment, classified under SIC code 351 (Internal Combustion Engines, not elsewhere classified). Depending on the ability of the engine manufacturers to pass the increased production costs forward, the equipment manufacturers may also be impacted, as well as the construction and forest product industries that purchase the equipment.

VII(D)(2) NONROAD ENGINES - EMISSION REDUCTION BENEFITS ASSOCIATED WITH PHASE I REFORMULATED GASOLINE

The control measure modeled for nonroad engines simulates the emission reduction benefits associated with the use of reformulated gasoline in nonroad engines in ozone nonattainment areas. The reformulated gasoline control measure described under the previous discussion of the on-highway control measures applies here, as well. The nonroad recreational vehicle categories for which emission reduction benefits were estimated include airport services, recreational, industrial, light commercial/utility, construction, farm, lawn and garden, and logging equipment (Pechan, 1994a).

VII(D)(3) MARINE EMISSION FEES

This control measure is based on a draft rule prepared for the California ozone FIP to control NOx emissions. The draft rule involved a three-tier emission fee structure based on a price of $10,000 per ton of NOx. With the fee structure in effect, vessel operators would control the maximum amount of NOx emissions possible as long as the cost was less than $10,000 per ton. Otherwise, vessel operators would presumably pay the fee (Pechan, 1994a). This control measure would potentially affect most commercial diesel-fueled marine vessels classified under SIC codes 441 (Deep Sea Foreign Transportation of Freight), 442 (Deep Sea Domestic Transportation of Freight), 443 (Freight Transportation on the Great Lakes), and 444 (Water Transportation of Freight, not elsewhere classified). However, the County Business Patterns did not report any establishments for SIC codes 441, 442, and 443 for the nonattainment area counties for which control costs were estimated. Consequently, these three SIC codes were not included in the economic impact analysis for this control measure

VII(D)(4) RECREATIONAL VEHICLES - CALIFORNIA STANDARDS

The control measure for recreational vehicles is based on a proposed rule developed by California in 1993. The rule would set hydrocarbon, NOx, and carbon monoxide emission standards for nonroad motorcycles, all-terrain vehicles, golf carts, and specialty vehicles with an engine size of 25 hp or more beginning with the 1997 model year. The rule would also establish hydrocarbon, NOx, and carbon moNOxide emission standards for specialty vehicles with an engine size of less than 25 hp beginning with the 1995 model year (Pechan, 1994a).

VII(E) COMPARISON OF ALTERNATIVE OZONE NAAQS ON AFFECTED SOURCES

This section discusses the impact of control measure selection on SIC codes for the three alternative standards. While the data are illustrative, they have limitations. For example, the Agency discovered that for a significant number of nonattainment areas under all of the alternative standards examined, VOC and NOx targeted reductions exceeded available VOC and NOx reductions. Consequently, for many nonattainment areas, the control strategies applied do not change appreciably from one alternative to another. What little change does occur between alternatives usually results from a change in the definitions of nonattainment areas, rather than from changes in control strategies within the same area. Figure VII-1 illustrates the number of control measures affecting different numbers of SIC codes (i.e., 1, 2, 3, 4, 5, and more than 5). Forty-eight control measures apply to the most stringent alternative (8H1AX-80), twenty-eight of which (fifty-eight percent) affect only one SIC code. Thirty-two controls apply to the 8H4AX-80 alternative, with nineteen (fifty-nine percent) affecting only one SIC code. Under the 8H5EX-80 alternative, twenty-seven measures were analyzed, of which fifteen (or fifty-six percent) affect only one SIC code.

Figure VII-2 displays the distribution of control measures that affect only one SIC code among the eight SIC code divisions they affect. The Manufacturing division (SIC codes 20 through 39) makes up about seventy percent of the SIC codes that are affected by only one control measure for the 8H1AX-80 alternative, with the Mining division (SIC codes 10 through 14) and the Transportation division (SIC codes 40 through 49) both associated with four SIC codes, or eleven percent of the total. The remainder of SIC codes are distributed among the Agriculture (SIC codes 01 through 09); Wholesale (SIC codes 50 and 51) and Retail (SIC codes 52 through 59) Trade; and Services (SIC codes 70 through 89) division; each division is associated with one SIC code (or three percent of the total) under the most stringent alternative. Under the 8H4AX-80 and the 8H5EX-80 alternatives, the Manufacturing division makes up about ninety percent of the SIC codes affected by only one measure. The Services division (SIC codes 70 through 89) accounts for the second highest number of SIC codes under the 8H4AX-80 alternative, with one SIC code each in the Transportation, Wholesale Trade, and Retail Trade divisions. Under the 8H5EX-80 alternative, the Transportation and Services divisions have the second highest number of SIC codes (2) affected by one measure. The Wholesale Trade, Retail Trade, and Public Administration divisions (SIC codes 90 through 97) account for the remainder.

FIGURE IV-1
THE EXPECTED EFFECT OF CONTROLS ON INDUSTRY

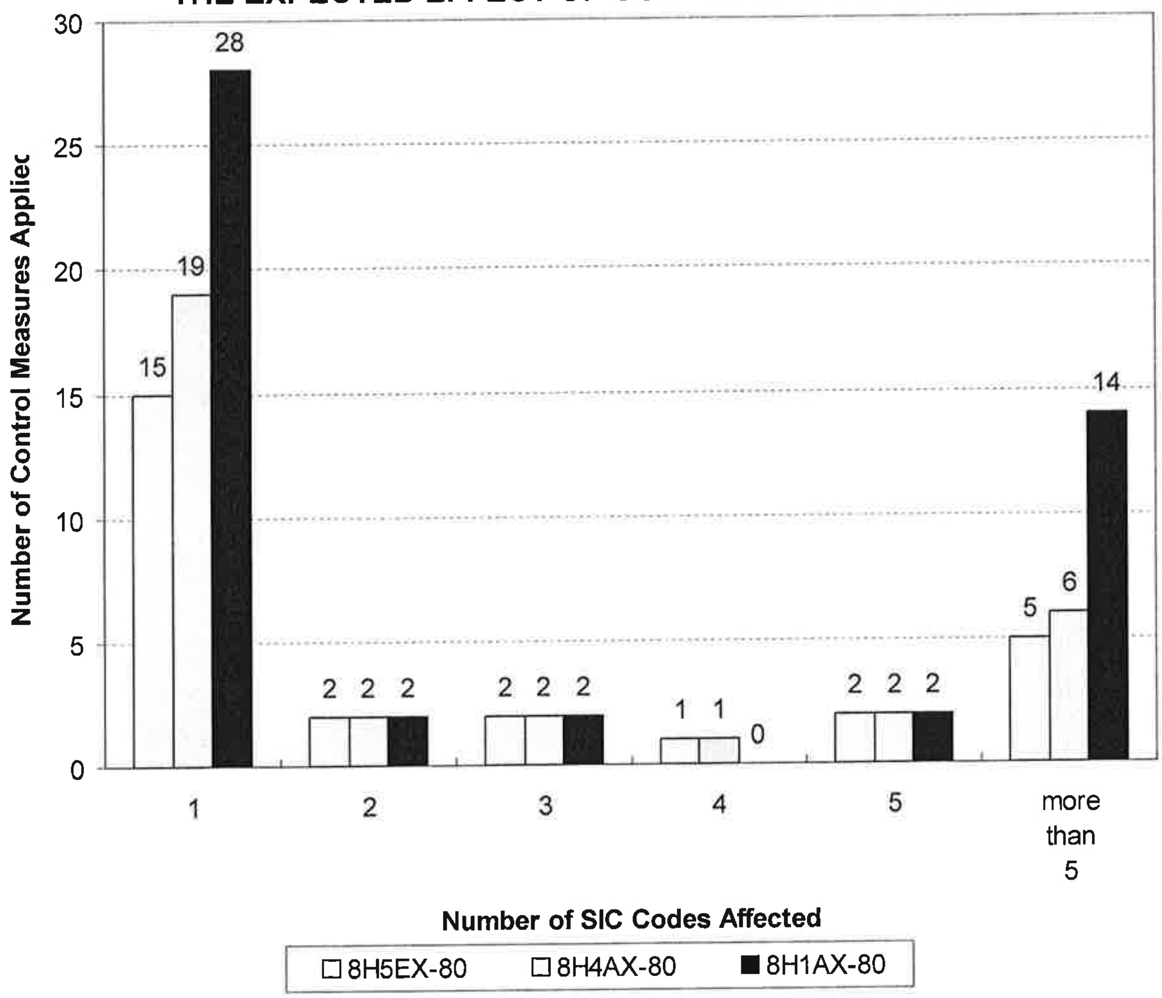
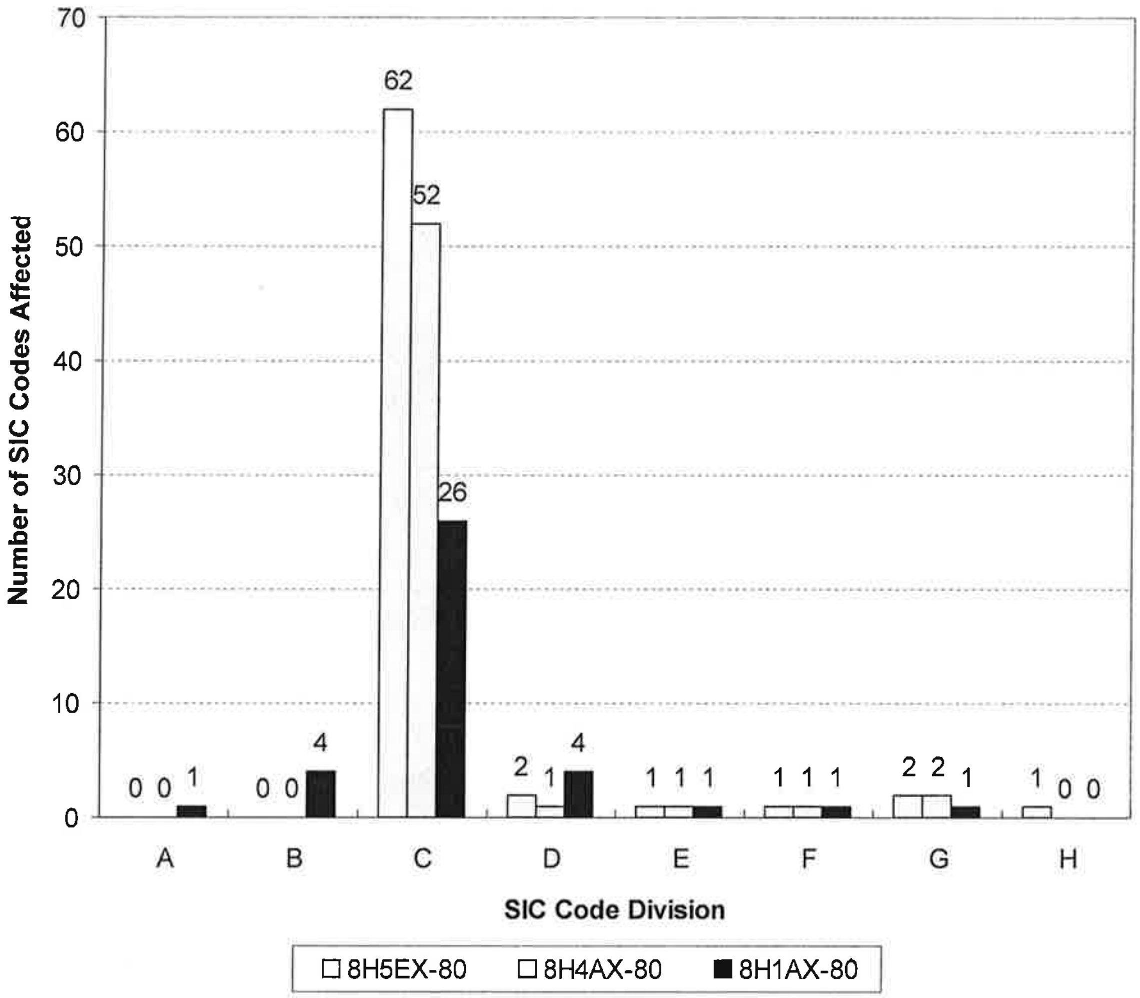


FIGURE VII-2
THE NUMBER OF SIC CODES AFFECTED BY ONE CONTROL MEASURE

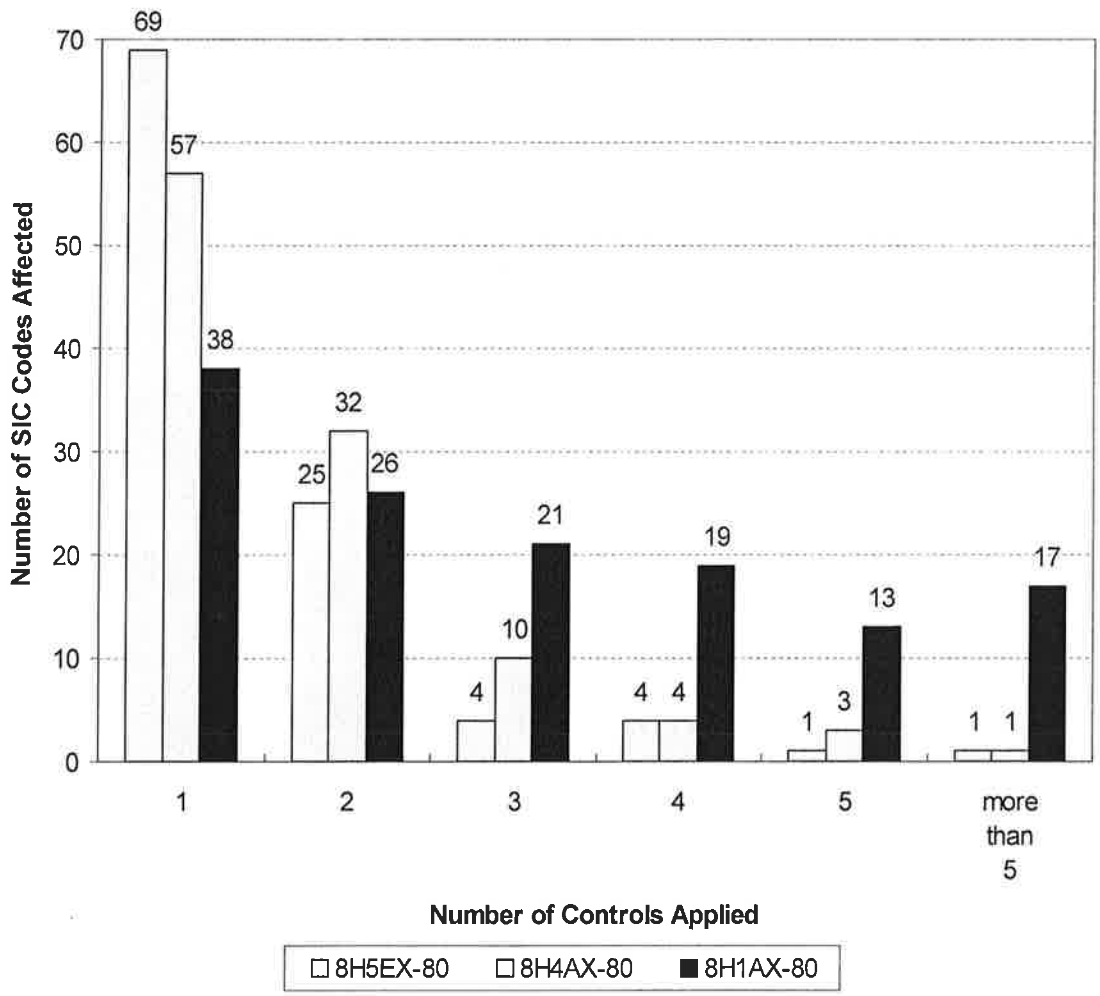


SIC Code Divisions

A	Agriculture	D	Transportation	G	Services
B	Mining	E	Wholesale Trade	H	Public Admin.

Figure VII-3 displays the relative number of SIC codes affected by different numbers of control measures (i.e., 1, 2, 3, 4, 5, and more than 5). Differences in the number of SIC codes affected by controls can be attributed to changes in the nonattainment area status of counties. The 8H1AX-80 alternative uses forty-eight measures affecting 134 different SIC codes. Thirty-eight SIC codes are affected by one measure (or twenty-eight percent of the total), and 117 SIC codes (or eighty-seven percent) are affected by five or fewer control measures. Under the 8H4AX-80 alternative, thirty-two measures are used affecting 107 unique SIC codes. Of these SIC codes, fifty-seven (or fifty-three percent) are affected by one control measure, and 106 (or ninety-nine percent) of SIC codes are affected by five or fewer control measures. Under the 8H5EX-80 alternative, twenty-seven measures affect 104 different SIC codes. Sixty-nine SIC codes, (or sixty-six percent)

FIGURE VII-3
THE EFFECT ON SIC CODES FROM CONTROLS



are affected by one control measure, and 103 SIC codes (or ninety-nine percent) are affected by five or fewer control measures.

The Agency believes that when the part 51 implementation process has been completed, the impact of applying optimal control strategies will differ from that illustrated above. The difference will be due to several factors. First, the part 51 analysis will assume subpart (2) does not apply to ozone NAAQS implementation. This will provide much needed flexibility to the ozone management process and allow regulators the opportunity to achieve targeted reductions through greater flexibility. Since the current classification scheme for nonattainment areas has been in place for a number of years, much of that flexibility within existing nonattainment areas has probably already been captured. Additional lower cost strategies will have to be found outside current nonattainment areas. Including new areas into nonattainment area definitions will probably increase the number of controls applied as well as the number of affected SIC codes. Second, the part 51 RIA will have two analytical advantages over the current methodology: a new, state-of-the-art air quality model which will incorporate ozone precursors and particulate matter (PM); and a revised emissions inventory which incorporates much of the latest engineering and scientific data about precursor reductions and their associated costs. Through these changes, the Agency will be to take advantage of the jointness in control that often occurs between ozone and PM.

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CHAPTER VIII ECONOMIC ASSESSMENT

VIII(A) INTRODUCTION

This chapter describes the economic impact analysis conducted for stationary and mobile source control measures. It serves as an indicator of possible economic impacts, not as a final analysis. Full assessment of the economic impacts associated with the proposed ozone primary NAAQS must wait until the part 51 implementation process has been completed. This analysis, while in places looks similar to a Regulatory Flexibility Screening Analysis (RFSA), should not be considered an RFSA, nor should this chapter be considered as fulfillment of any SBREFA requirement. The results of this analysis serve as inputs to the development of implementation strategies which will help attain the proposed standard while mitigating possible disproportionate impacts on specific sectors or segments of the economy (e.g., small businesses and governments).

Because of the number of industries/entities potentially affected by this NAAQS, EPA developed a cost-to-sales ratio methodology for use as a screening tool to identify industries and entities for which control measure impacts may be significant. The approach compares average control measure costs with average sales revenue of establishments in potentially affected industries on a SIC code basis (OMB, 1987). The analysis was conducted at the 3-digit SIC code level because of the extensive number of 4-digit SIC codes potentially affected by the control measures and the fact that financial data are more often available at the 3-digit SIC code level. Because the methodologies of the economic impact and small entity screening analyses are similar, the methodologies and results of these analyses are described together in this chapter. This analysis was conducted for three alternative NAAQS (i.e., 8H1AX-80, 8H4AX-80, and 8H5EX-80) which are more stringent than the current NAAQS (i.e., 1H1EX-120). The costs used for the screening analysis are the incremental costs of each alternative relative to the current ozone standard. Cost-to-sales and cost-to-expenditure ratios are not included in this RIA.

Since the small entity screening analysis has been designed to provide input into the part 51 RIA with regard to RFA and SBREFA requirements, the staff designed its analysis to follow the same steps. The RFA requires Federal agencies to give special consideration to the impact of a regulation on small businesses to determine whether or not the proposed regulation will have a significant economic impact on a substantial number of small entities. According to a standard rule of thumb often used in previous rulemakings at EPA and other agencies, a significant impact on small entities occurs when:

- 20% or more of the affected small entities[1] have an expected cost (of regulation) to sales ratio equal to or greater than 3%, and
- if the 20% criteria is met, that the actual number of significantly affected small entities is more than 100.

1 SBREFA guidelines state the definition for "small" for any given industry should come from the Small Business Administration listing codified in 13 CFR 121.201.

This RIA uses one hundred employees as its definition of "small" for this RIA because: 1) control cost data were not generated on a firm-level; and 2) published sales data typically are not available for a five hundred employee threshold.[2]

Control measures often affect entities at more than one point from production to final sale (e.g., manufacturing and retail trade). For example, automobile manufacturers are directly affected by many measures, but other entities are indirectly affected, such as automobile dealerships and businesses purchasing fleet vehicles. Given the complexities of determining the degree of cost pass-through from the directly affected entities, EPA analyzed only the direct impact of each control measure on entities.[3]

The reader should note this analysis did not include any ongoing work of the Subcommittee of the Clean Air Act Advisory Committee (CAAAC) when it estimated the economic impacts presented in this chapter. As indicated earlier in this RIA, the control strategies which emerge from this process will most likely cost less and be more environmentally effective than the ones analyzed here. Further, this RIA does not take into account any jointness which may exist in control strategies for ozone and PM. Such jointness may have significant bearing on the costs, benefits, and economic impacts associated with the implementation strategies for reducing ozone and PM concentrations. Since this RIA and this economic analysis employed existing non-integrated technical models and implementation strategies, results from these analyses should be interpreted with these limitations in mind.

The economic impacts presented in this chapter only reflect the direct costs of the application of the control measures selected in the cost analysis summarized in Chapter VI. The Agency recognizes that the economic impacts associated with the control measures, both positive and negative, area distributed beyond the directly affected industries (e.e., the natural gas industry receiving additional revenues due to increased demand for cleaner fuels, the pass-through effect of regulatory costs on consumer demand), but was unable to prepare estimates of these because of limited data. The EPA will provide market impact estimates using a sample of affected industries for the costs associated with the implementation plans that will develop during the part 51 implementation process.

VIII(B) COST EFFECTIVENESS

VIII(B)(1) BACKGROUND

Executive Order 12866 states that when it is feasible, benefit-cost analysis shall be used to evaluate and compare regulatory alternatives, which is the primary focus of the Ozone NAAQS RIA. Another tool that is used when benefits cannot be quantified is the measure cost-effectiveness. Cost-

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2 The one hundred employee threshold was also used for the RIA and RFA analyses for the California FIP and the PM NAAQS review. From a consistency standpoint, one hundred employees was the appropriate choice.

3 Judicial precedent has been set for RFA analyses that such analyses are required only for small entities which are directly regulated [Mid-Tex Electric Cooperative, Inc. v. FERC, 773 F.2d 327 (D.C. Cir. 1985)].

effectiveness is used to rank a set of least-cost alternatives that achieve differing degrees of air quality improvements or health risk reductions. The ranking of alternatives is an important tool that allows policy-makers to identify inferior and/or dominant strategies among regulatory alternatives[4]. For environmental policy, cost-effectiveness is calculated as the cost of an alternative divided by the expected emission reductions.

Routinely, the EPA provides a measure of the cost-effectiveness (C/E) of regulations that allows for a historical comparison of effectiveness of a rule with other regulations passed by the EPA when actual benefit cost analysis are not done. Traditionally, C/E is measured as total national costs of the rule divided by national emission reductions. For example, the control of volatile organic compounds (VOCs) from consumer and commercial products has been proposed to reduce 82,000 Mg/year of VOC nationwide at a cost of $27.0 million (1991$). This yields a C/E measure of $ 330 per Mg, which can be used to compare with other EPA regulations.

The EPA has been requested to consider new approaches towards presenting cost-effectiveness comparisons in its rules that target the reduction of ozone. The primary concern is that the traditional C/E measure does not consider the appropriate measure of emission reductions to compare with a program's cost. Under section 183(e) of the Clean Air Act, the EPA is tasked with developing standards that will facilitate compliance with the Ozone NAAQS through the control of VOCs that are emitted from consumer and commercial products, such as: hair sprays, deodorants, paints and other coatings. Some of these rules will be implemented nationwide. Consequently, emission reductions will be achieved in both ozone nonattainment areas as well as attainment areas.

EPA recently raised this issue in its Consumer and Commercial Products (CC&P) rule and received the comments summarized below. EPA is repeating the request for comments here since this RIA will be reviewed by a much broader audience. The comments on the CC&P rule received on the various methods to measure C/E for these rules reflect a wide dispersion of opinions. Some commenters recommend that the EPA maintain the traditional C/E measure because restricting the measurement to a subset of anticipated emission reductions does not accurately reflect all of the benefits of the rule. Other commenters argue that the traditional C/E measure creates a bias against tailored, local, and seasonal approaches. They state that the C/E methodology should measure that cost against emission reductions that actually affect the nation's public health. Thus weighting reductions by their relationship to improvements in public health is a recommended approach. Similarly, another commenter stated the EPA should concentrate on measuring C/E for the primary objective of the standard - meeting the NAAQS in nonattainment areas. This commenter also recommend that EPA consider only emission reductions that occur during the "ozone season." Finally, other cementers support all variations of the measure of C/E.

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4 It is often assumed that cost-effectiveness can be used as a proxy for a benefits valuation. Cost-effectiveness is **not** a proxy for the quantification of benefits because two control strategies may achieve the same level of emission reductions (and thus accrue the same level of benefits), but one strategy may do so at a much higher cost. Cost-effectiveness would identify the higher cost strategy as inferior and thus it would not be implemented, even though it achieves the same level of benefits as the other alternative.

Not all of the comments received will be relevant to the Ozone NAAQS since the traditional C/E measure would be the same as a measure restricted to nonattainment area emission reductions. However, the audience of this report is broad and can provide additional insight on the issue not only as it pertains to the NAAQS, but also for other programs to be developed in the future. Below is a general discussion of the potential approaches and issues of measuring C/E.

VIII(B)(2) ALTERNATIVE COST-EFFECTIVENESS METHODOLOGIES

The first alternative approach that has been suggested for rules that are implemented nationwide is to measure C/E for emissions occurring in ozone nonattainment areas only, even if a control alternative is expected to achieve additional reductions outside of nonattainment areas. The premise for this approach is that the primary objective of such control strategies is to reduce levels of ozone to meet the NAAQS in nonattainment areas. In doing so, the measure would compare national cost (for control in both nonattainment areas and attainment areas) with emission reductions in nonattainment areas only. This has an advantage of presenting a narrower measure of the effectiveness of a strategy to achieve the primary objective - reducing levels of ozone to meet the NAAQS. However, it also presents a measure that might be used to compare with the traditional approach; these are not comparable. The traditional measure places equal value on attainment area and/or non-ozone season reductions; alternatives would be based on the emission reductions that are the focus of the regulatory program.

To account for the multiple objectives achieved by such rules, the measure of cost-effectiveness should represent some weighting of the objectives, or it must focus on the most important objective to the exclusion of the others. The EPA's traditional measure of C/E provides a measure of equal weighting (or equal value to society and the environment) given to emission reductions in both nonattainment areas and attainment areas. The alternative approach assumes that the secondary affect of reductions in attainment areas has no value to society and the environment, and applies a zero weighting to attainment area emission reductions. Numerous studies demonstrate that a positive value exists for emission reductions in attainment areas by decreasing damages to ecosystems, agricultural crops, and other species. However, this value is likely to be less than the value to be placed on nonattainment area emission reductions. Thus, a weighting that is between 0 and 100 should be applied to attainment area emission reductions, but the EPA does not have a method to determine the proper weight to apply to attainment area emission reductions. Therefore, for rules that achieve reductions nationally the C/E can be presented in a range representing (1) equal weighting for all emission reductions through the use of the traditional measure of C/E, and (2) zero value weighting to attainment area reductions through the use of the first alternative measure of C/E; recognizing that the most appropriate value is between these two extremes.

A second alternative that is suggested is to measure C/E for the "ozone season" only (i.e., for emission reductions achieved during typical peak ozone months of the year). This measure would compare national costs with a subset of national emission reductions - those reduced in nonattainment areas during peak ozone months of the year. This approach would in effect apply an additional breakdown of the weighting of nonattainment area emission reductions. As is discussed above, the weight could be anywhere from 0 to 100, with the difference being applied to non-ozone season emission reductions. The value of non-ozone season emissions could be lower than those of the ozone season, but not zero since there are studies showing positive health benefits to reductions during all seasons of the year.

This approach would allow valid comparisons to be made between the cost effectiveness of national year-round rules and, for example, nonattainment area specific rules applying during the ozone season. Such a comparison of cost effectiveness is valid because it is a comparison of the cost (wherever and whenever incurred) to achieve emission reductions that are the regulatory objective - in this case, nonattainment area ozone season emissions. Using a traditional cost effectiveness approach one cannot compare the cost effectiveness of such differing control strategies.

VIII(C) METHODOLOGY AND LIMITATIONS OF IMPACTS ANALYSIS OF EACH CONTROL MEASURE

The analysis excluded eight source categories from this chapter's analysis because they had zero or negative costs.[5] Seven SIC codes in the Interim 1990 Point Source Inventory were mis-coded and were removed. The analysis also excluded residential natural gas space heaters from the analysis because County Business Patterns did not report any establishments for SIC code 343 (Heating Equipment, Except Electrical and Warm Air; and Plumbing Fixtures) in the counties for which the control measure was selected. A list of these control measures and the reasons for exclusion can be found in Appendix D, Table D-1. Two types of analyses were performed for the remaining control measures. The first analysis estimates cost-to-sales ratios for SIC codes potentially affected by each individual control measure selected under each NAAQS alternative. The methodology and results of this analysis are presented in sections B and C, respectively. The second analysis estimates cost-to-sales ratios for SIC codes potentially affected by more than one control measure. The methodology and results of the second analysis are presented in sections D and E, respectively.

Appendix D, Table D-2 presents an overview of the data sources used and the methodologies employed for each of the source categories potentially affected by a NAAQS alternative. To develop cost-to-sales ratios for the incremental control measures, the RIA team first identified the potentially affected SIC codes. Control measure and the SIC code impacts are presented in Chapter VII. Chapter VII also describes the methods used to identify the SIC code(s) potentially affected by each control measure. The following sections are organized by the following four general emission source categories:

- Point sources are relatively large emitters of air pollutants. Because of their significant contribution to total emissions, each individual point source is identified in the Interim 1990

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5 Negative costs for VOC measures are due to recovery credits for reduced VOC use or production cost savings.

Inventory. In addition to emissions data, additional source-specific information is typically available, including operating rate and associated SIC code.

- Area sources emit smaller quantities of air pollutants than point sources. Typically, each individual emissions source and its associated SIC code is not delineated in the area source emissions inventory. One example of an area source category is VOC emissions from automobile refinishing operations.
- On-highway sources comprise motor vehicles that are generally used on the nation's road system (e.g., automobiles, motorcycles, freight trucks).
- Nonroad sources comprise mobile sources that do not use the nation's roads (e.g., marine vessels, locomotives, airplanes).

VIII(C)(1) STATIONARY POINT SOURCE CONTROL MEASURES

VIII(C)(1)(a) METHODOLOGY

To calculate a national average cost per establishment, the analysis team estimated the total number of establishments potentially affected by each measure. Point sources in the Interim 1990 Inventory are assigned a unique plant identification code. The estimated number of affected establishments for each point source control measure is represented by the total number of unique plant identification codes affected. Estimates of affected establishments were summed for each point source control measure selected under each ozone NAAQS alternative. These estimates were then divided into the total cost of each control measure to develop the average cost-per-establishment for each point source control measure.

Each point source in the Interim 1990 Inventory is also identified by an SIC code, which was used for linking the average cost per establishment with a measure of the national average sales per establishment for each potentially affected industry. National sales data are generally available by 3-digit SIC code from the Bureau of the Census' Enterprise Statistics and related publications (DOC, 1989a,b; DOC, 1990a,c-g; DOC, 1991a,b; DOC, 1995a,b). In the absence of revenue data, the team substituted payroll data from County Business Patterns. This analysis utilizes average national sales data. For each potentially affected SIC code, the analysis obtained the following two values: (1) a national average sales per establishment over all employee size categories, and (2) a national average sales per establishment for establishments with less than one hundred employees. Some SIC codes did not have sufficient data to calculate an average sales per establishment value for small establishments. In these cases, EPA calculated the ratio of average sales per small establishment to average sales for all establishments at the 2-digit SIC code level. This ratio was then applied to the average sales per establishment over all size categories at the 3-digit SIC code level to estimate average sales per small establishment for that 3-digit SIC code.

For consistency, EPA projected the Bureau of Census' revenue data to 2007 levels using the same BEA growth factors that were used to project emissions (DOC, 1990b). Since control cost data reflect 1990 price levels, this analysis updated the 1987 Bureau of Census price levels to 1990 dollar terms using the ratio of the 1987:1990 gross domestic product (GDP) implicit price deflator. For some SIC codes where 1987 data were not available, 1992 sales revenue data were used, instead. Separate growth factors were developed to project sales for these SIC codes from 1992 through 2007. The average sales per establishment by SIC code was calculated for small businesses by dividing total sales for establishments with less than one hundred employees by the number of establishments with less than one hundred employees. Similarly, the average sales per establishment for all employee size categories was calculated by dividing total industry revenue by the total number of establishments. This analysis divided the average cost per establishment for each point source control measure by the average sales per establishment for each potentially affected SIC code. Cost data were linked to sales data at the greatest level of common SIC code detail – generally the 3-digit SIC code level. For each control measure and affected SIC code, EPA computed a cost-to-sales ratio for small establishments and a cost-to-sales ratio for all establishments.

Certain affected point sources from the Interim 1990 Inventory are identified by SIC codes associated with government entities. For these SIC codes, the technical team employed a similar methodology for calculating average cost-to-sales ratios. To gauge the impact of control measures on government entities, EPA compiled expenditure information for government functions identified as potentially affected by point source control measures. Data on government expenditures by type of government (Federal, State, county, or municipality) and government function (e.g., highways) are available from the Census of Government (DOC, 1990e). The data reported for specific government functions were linked to the corresponding SIC code(s) to provide government expenditures by county for each SIC code and county affected by one or more point source control measures. Average annual 1987 government expenditures by county were projected to 2007 using BEA growth factors for State and local governments. The average cost of each applicable control measure by county was then divided by average expenditures by county to determine a ratio analogous to the cost-to-sales ratio developed for private industries. For potentially affected entities classified in SIC code 971 (National Security) in the point source inventory, control costs were summed for all counties in the United States and divided by Federal expenditures to develop an appropriate cost-to-expenditure ratio. Because government entities do not operate in a competitive free market, they have more flexibility in trying to offset additional costs, including reallocating funds from other government functions, and/or raising taxes or user fees. Therefore, a cost-to-expenditure ratio of 5 percent was used to determine potentially significant adverse impacts on government entities.

VIII(C)(1)(b) LIMITATIONS OF POINT SOURCE CONTROL MEASURE METHODOLOGY

Source-specific cost estimates were not prepared for each emissions source. In some cases, costs were estimated by applying an average cost-effectiveness value to the emission reduction estimated for each point source. Also, since the estimated emission reduction is calculated based on the emissions reported for that source in the Interim 1990 Inventory, any limitations associated with that inventory are reflected in the cost-to-sales ratio analysis.

Cost estimates were developed using information available before 1994, and, in some cases, reflect information from the mid-1980s. Recent and future developments in control technology may result in lower cost estimates than those utilized for this analysis. A complete discussion of the methods employed in estimating point source control measure costs can be found in the docket (Pechan, 1994a; Pechan, 1994b; Pechan, 1994d).

Point source cost estimates used in this analysis were available as a total for each nonattainment area/control measure combination. Identification of the plants affected by each control measure in each affected nonattainment area county were also provided. To link total costs to individual point sources, the team assumed all plants affected by a given control measure incur the same costs. In reality, plants in different industries and plants of different sizes incur different costs. Therefore. the average cost per establishment reported for each control measure/SIC code combination may be over- or under-stated.

Revenue data represent national averages by industry. Given the number of entities potentially affected by the ozone NAAQS alternatives, it was not practicable to compile revenue information for each entity. Furthermore, the Interim 1990 Inventory provides the plant name for each point source - not firm ownership. Identifying the company that owns each plant would be a complicated and resource-intensive process. Given these problems, the analysis was conducted on an establishment-level rather than a firm-level basis. Sales revenue data are readily available by SIC code for different employee size categories from the U.S. Bureau of the Census. Because these revenue data are not generally available by State or county, average national sales revenues were compared with point source costs for each potentially affected SIC code.

Finally, sufficient data were not reported in the Interim 1990 Inventory to classify affected plants as small establishments. Therefore, EPA used this RIA's average cost per establishment to establish potential impacts on small businesses. Since average costs for small entities differ from the average costs calculated in this analysis, small business impacts are also mis-stated.

VIII(C)(2) STATIONARY AREA SOURCE CONTROL MEASURES

VIII(C)(2)(a) METHODOLOGY

Cost data for each area source control measure were provided by nonattainment area and control measure. Potentially affected SIC codes are provided in Chapter VII of this report. To estimate the number of affected establishments, EPA used county and SIC code data reported in the 1990 County Business Patterns (DOC, 1990c). EPA estimated average costs for each area source control measure by dividing the total control measure costs on a national level by the total number of establishments obtained using one of the following means:

- For control measures affecting basic industries that make products that are generally exportable out-of-state (e.g., automobile manufacturing), sum the total number of establishments for each affected SIC code on a national basis.

- For control measures assumed to serve a national market, (and would all be affected by of this measure in other areas of the country), identify the number of establishments on a national level based on information from related analyses. For example, the number of firms on a national level affected by the CARB and SCAQMD standards for aerosol paint reformulation is based on the results of a survey conducted by CARB.
- For control measures affecting service industries assumed to involve localized markets (e.g., P-V valves for gasoline service stations), or with an unknown geographic market (e.g., synthetic fiber manufacturing), sum the number of establishments for each SIC code-nonattainment area county combination.

For bulk terminals; industrial adhesives; surface coating operations and industrial fuel combustion, estimates for the number of potentially affected establishments. [6] Costs for these control measures were estimated for establishments that emit from 25 up to 100 tons per year of VOC or NOx. The uncontrolled emissions for all of the establishments associated with the SIC codes were summed and multiplied by an 80 percent rule effectiveness value factor and the control efficiency used in ERCAM to estimate total emission reductions. Total costs were then calculated for each control measure by multiplying the total emission reduction value by the control measure cost-effectiveness value used in ERCAM. The total cost was then divided by the total number of establishments used to develop the total cost estimate to obtain an average cost per establishment. This methodology estimated average costs per establishment for a sample of establishments potentially affected by a control measure when information on the total number of potentially affected establishments was unavailable. The methodology was simplified by calculating a constant average cost per establishment value for all SIC codes affected by a control measure.

The RIA compared average cost per establishment data to average sales per establishment data for each affected SIC code to determine potentially significant economic impacts. Average sales per establishment data were compiled for affected SIC codes using the methods described in the point source methodology section. For each potentially affected SIC code, the average cost per establishment was then divided by the average sales per establishment to yield the cost-to-sales ratio for each control measure-SIC code combination.

VIII(C)(2)(b) LIMITATIONS OF THE AREA SOURCE CONTROL METHODOLOGY

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6 Because area source control measures obtain emission reductions from smaller sources not included in the point source inventory, data from the NEI were used to estimate average costs per establishment for each of these control measures. The NEI was developed by EPA in 1995 and 1996 to improve photochemical grid modeling of ozone precursors. The NEI contains 1990 base year emission inventories supplied by the States after the Interim 1990 Inventory was developed. The NEI was used for this analysis because it contains emission data for a significant number of plants that emit less than one hundred tons per year of uncontrolled VOC and NOx emissions.

All of the limitations described in the point source control measure methodology also apply to the area source control analysis. There are additional analytical limitations associated with the area source control methodology. First, there may be significant differences between the number of establishments associated with the area source portion of the emissions inventory and the number of establishments in affected counties reported in County Business Patterns. Because area sources are not individually inventoried, the actual number of establishments affected by the control measures is unknown. Therefore, there is no direct relationship between these emission estimates and the number of establishments reported in County Business Patterns.

Second, for the area source control measures that affect emission sources from entities classified under a variety of SIC codes, it was difficult to clearly identify the SIC codes that would actually be affected. These control measures include the NOx measures for industrial coal, oil, and natural gas combustion. The RIA used the NEI as the source for identifying the SIC codes most likely affected. However, this analysis cannot estimate the extent to which the SIC codes analyzed under- or over-estimate the SIC codes actually affected.

Finally, the average cost per plant does not differ between sources because information is not available to identify specific costs for individual industries. Therefore, costs were allocated evenly across affected establishments. The EPA recognizes that this is a shortcoming of the analysis, but information is not available to determine which SIC codes/industries will incur higher per establishment costs relative to other affected SIC codes/industries.

VIII(C)(3) MOBILE SOURCE CONTROL MEASURES

This analysis relied upon existing mobile source RIAs prepared for specific mobile source regulatory programs that form the basis for some of the incremental control measures in this report. The RIAs typically do not estimate the economic impacts of the control measure on the industries affected. Instead, these RIAs generally calculate the annual cost and the per unit retail price increase associated with a regulation. For example, the impact of the Federal reformulated gasoline (RFG) control measure was estimated in terms of the annual cost increase and the increased retail price per gallon of gasoline, instead of estimating the impact of the RFG program on the refinery industry. A series of documents describes how these mobile source RIA costs were incorporated into ERCAM for use in estimating the costs and emission reductions for the mobile source control measures (Pechan, 1994a; Pechan, 1994b).

For consistency with the stationary source methodology, the RIA determined the impact of these measures on entities that are directly impacted. Because of significant differences in the implementation and cost estimation for the mobile source control measures, it was not possible to develop a general methodology for use with all of these measures. The following sections describe the methodology that was employed for each control measure.

VIII(C)(3)(a) ON-HIGHWAY CONTROL MEASURES

Federal Reformulated Gasoline: For this category, the RIA calculated cost-to-sales ratios for refineries. The average cost per establishment for producing RFG was calculated by dividing the total of the RFG program costs by the total number of establishments that are projected to produce RFG. This cost-per-establishment figure was then compared to national average sales-per-establishment data to analyze the potential for significant economic impacts in the gasoline refining industry.

To estimate the total number of potentially affected establishments for this control measure, it was first necessary to obtain the total number of refineries that produce gasoline. Contacts with the American Petroleum Institute and the National Petroleum Refinery Association indicate that gasoline and other petroleum product information is not available for each refinery in the United States. The total number of refineries that produce gasoline was estimated by dividing the number of U.S. gasoline producing refineries as surveyed in a 1991 EPA study by the total number of U.S. refineries surveyed in that study, and then applying this ratio to the January 1991 total number of refineries as published in the Petroleum Supply Annual (DOE, 1991).

The RIA assumes the proportion of RFG consumption relative to national gasoline consumption (excluding California) at 53 percent. For this analysis, EPA calculated an average cost-per establishment based on an estimate of the number of gasoline refineries that would be producing RFG under each of the ozone NAAQS alternatives. These estimates were generated based on county-level fuel consumption estimates. On-road fuel use was estimated by dividing 1990 county-level vehicle miles traveled (VMT) data by vehicle type-specific fuel economy (miles per gallon) available from the MOBILE4.1 Fuel Consumption Model (EPA, 1991). Off-road gasoline consumption was estimated by applying the ratio of 1990 VOC emissions for off-road gasoline vehicles to onroad gasoline vehicles (25 percent) to county-level on-road gasoline consumption. The ratio of total gasoline consumed in nonattainment areas where the Federal RFG measure was selected to total U.S. gasoline consumption (both on-road and nonroad gasoline) was then calculated for each alternative. This ratio was applied to the estimated total number of gasoline refineries in the United States to compute the estimated number of gasoline refineries affected by the Federal RFG. The team developed separate establishment estimates for each ozone NAAQS alternative (i.e., as more areas are assumed to implement this measure under more stringent NAAQS alternatives, more gasoline refineries are assumed to be affected).

The Office of Mobile Sources has developed three RIAs describing the costs for RFG: a February 1993 Vehicle Evaporative Emissions RIA (EPA, 1993a), a December 1993 Reformulated Gasoline RIA, and a June 1994 Renewable Oxygenate Requirements RIA. At the time that RFG costs were input into ERCAM, only the February 1993 RIA had been released. The December 1993 costs of Phase II RFG declined substantially from the costs used in ERCAM, which estimated 6.8 to 8.3 cents per gallon for 7.5 psi Reid vapor pressure (RVP) fuel and 8.4 to 10.2 cents per gallon for 6.8 psi RVP fuel. The December 1993 RIA revised the Phase II cost to 4.2 to 6.1 cents per gallon, for a total annual cost of approximately $1 billion. The December RIA also stated that smaller refineries are not required to produce RFG, and will not be significantly impacted because of sufficient demand for conventional gasoline. The June 1994 RIA rulemaking requires that 30 percent of the mandatory oxygen content specification for RFG be obtained from renewable oxygenates.[7] This RIA estimated the total additional cost of the renewable oxygenate program for Phase I to fall between $4 million and $60 million per year, and for Phase II costs would range from $22 million to $60 million annually (EPA, 1994). The RIA also estimated the renewable oxygenate requirement will have one-time costs of approximately $15.6 million for additional storage facilities and approximately $2 million for additional blending capacities. A subsequent court ruling on September 13, 1994, stayed the renewable requirement pending judicial review.

Because revised RFG program costs are not reflected in ERCAM, the analysis must be caveated in that the RFG program and costs have changed since they were originally modeled. The costs of the program are likely to be higher or lower than those employed in this analysis, depending upon the number of areas that ultimately are assumed to implement the measure, and the fate of the renewable oxygenate requirement. Since that time, the program has been dropped and future analyses will be adjusted accordingly.

Low Emission Vehicle Program: The California LEV program will impact automobile manufacturers and indirectly impact automobile dealerships, operators of fleet vehicles, and general consumers. This section presents the approach used to generate cost-to-sales ratios for automobile manufacturers, as well as quantitative information on the potential indirect impacts of the LEV program on automobile dealerships.

Impact on Automobile Manufacturers: Because automobile manufacturers serve a national market, the RIA assumed all of the establishments reported in County Business Patterns for SIC code 3711 would be affected by this control measure. The RIA summed the total cost of this measure across all affected nonattainment areas and compared this sum to the total average revenue per automobile manufacturer. This approach must be caveated because actual impacts may differ from those presented in the cost-to-sales ratios due to a lack of cost data relating to nonattainment area-specific implementation. For example, the estimated cost per vehicle may vary depending upon the number of areas affected, and, therefore, the number of automobiles that will be required to meet the program's requirements. Also, the assumption that all automobile manufacturing establishments are affected by this measure under each alternative may overstate the number of affected establishments.

Impact on Automobile Dealers: As stated previously, this RIA analyzes the potential impacts of control measures, including the California LEV program, on directly affected entities. An RFA analysis was previously conducted for a national low emission vehicle (NLEV) program (Pechan, 1995). For this program, which is included in the control strategy baseline for this analysis, the RIA estimated the potential for indirect impacts on automobile dealers. The California LEV program requires that 10 percent of vehicles be zero-emission vehicles (ZEVs) beginning in 2003. The EPA's NLEV regulations would require that 100 percent of model year 2001 automobiles meet California's LEV standards. California's standards are defined as 0.075 gram per mile (gpm) nonmethane organic gases (NMOG),

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7 To ensure that the ozone benefits from the RFG program are not adversely affected by the requirement, EPA requires that during the VOC control period, only renewable oxygenates that do not exhibit volatility-related commingling effects when mixed with gasoline would receive renewable oxygenate credit.

3.4 gpm CO, and 0.2 gpm NOx. Unlike the California LEV program, the NLEV program would not require that any vehicles be ZEVs.

For the NLEV program, the RIA performed a worst-case analysis for automobile dealerships assuming full-cost pass through to dealers and no cost pass through to consumers. This analysis concluded the NLEV program would not have a significant economic impact on automobile dealerships. The cost-to-sales ratios reported for this analysis ranged from 0.1 percent to 0.3 percent for large dealerships and 0.2 percent to 0.8 percent for small dealerships (Pechan, 1995). Similar impacts on automobile dealers may be expected from the California LEV program.

Inspection and Maintenance (I/M) Programs: The enhanced I/M program will directly affect households in nonattainment areas for which the control measure was selected. For the ozone NAAQS review, EPA relies on the results of a detailed RIA of this program that was conducted for the California ozone FIP (Pechan, 1994c). This analysis evaluated the impacts of an enhanced I/M program based on projected costs as a percentage of total household transportation expenditures and household income. The increased automobile repair expenditures under the enhanced I/M program were compared to income and pre-control transportation expenditures for households in different income stratifications. Ratios of average percent of income spent on transportation (with and without control costs) to average income for different income levels, provide pre-control and post-control comparison ratios.

For nonindividually owned vehicles, a modified version of the above analysis was employed. Instead of estimating expenditures and control cost per capita, these costs are estimated per vehicle and applied to fleet vehicles. An analysis was conducted comparing the percentage increase in annual expenditures per vehicle for fleet operators, assuming inspection failure. An analysis of the impact of the enhanced I/M program on small businesses in the car rental industry and for SIC code 7513 Truck Leasing and Rental, Without Drivers was also conducted by developing cost-to-sales ratios for these industries. Additionally, the impact of a centralized test-only inspection program on the automobile inspection and repair industry was evaluated. Appendix B presents the methodology, limitations, and results of the enhanced I/M program analysis for the California FIP, modified when necessary for the ozone NAAQS review.

An I/M flexibility rule has been finalized (60 FR 20934, April 28, 1995) which revises some of the program requirements that had been earlier assumed in developing enhanced I/M costs for ERCAM. These revisions include the establishment of a separate "low enhanced" performance standard; deletion of the prohibition that motorists can receive only one hardship exemption during a vehicle's lifetime; and for the "high enhanced" performance standard, adding a visual inspection of the positive crankcase ventilation (PCV) valve on all model year 1968-1971 light-duty vehicles (LDVs) and light-duty trucks (LDTs) and of the exhaust gas recirculation (EGR) valve on all model year 1972-1983 LDVs and LDTs. For areas that may choose to adopt the low enhanced performance standard, emission reductions and costs estimated by ERCAM would tend to overstate actual values.

VIII(C)(3)(b) NONROAD CONTROL MEASURES

This section describes the analytical approaches employed in the RIA and RFA analysis for nonroad source control measures. The limitations associated with each approach are also identified.

California Phase II Exhaust Standards for Nonroad Diesel Engines ≥175 HP: This measure was analyzed for its effect on the heavy-duty nonroad diesel engine manufacturing industry because engine manufacturers are directly affected by the control measure. Estimating the number of affected establishments for this control measure was problematic. It is possible, for example, that all manufacturers of heavy-duty nonroad diesel engines will produce engines that meet CARB's Phase II standards if the program is implemented in several areas of the country. However, only a subset of heavy-duty nonroad diesel engine manufacturers may produce engines meeting this standard if this control measure is selected for only a few nonattainment areas.

As a preliminary approach, EPA employed nonattainment area-specific establishment data for SIC code 3519 (Internal Combustion Engines) and collected establishment data from County Business Patterns for only those counties assigned the CARB Phase II standard as a control measure. This process may underestimate the number of potentially affected establishments because manufacturers located outside nonattainment areas may also sell engines in nonattainment areas that must comply with the standard. However, no information is available for improving the estimate of affected establishments at this time. Understating the number of establishments results in an overestimation of the cost-to-sales ratio impacts because a lower number of affected establishments results in a higher cost-per-establishment value that is then compared to the average sales-per-establishment value.

For its screening analysis, EPA used the national value of shipments and the number of establishments that manufacture heavy-duty nonroad diesel engines from Census of Manufacturers' data to estimate average costs per establishment. To estimate the number of establishments at the county level, EPA used the ratio of the national value of shipments for heavy-duty nonroad diesel engines to the total national value of shipments for all engine types reported under SIC code 3519 (70 percent). This ratio was used to estimate the number of establishments potentially affected within each nonattainment area county for which the control measure was selected. The total cost for all nonattainment area counties was then divided by the total number of establishments estimated for the counties to calculate the average cost-per-establishment for this control measure.

California Reformulated Diesel Fuel: Federal low-sulfur diesel fuel regulations have been included in the base case analysis. California reformulated diesel regulations are quite similar to the Federal program, except that the Federal regulations only apply to on-highway vehicles, while the California regulations also apply to nonroad vehicles.

The RIA estimated the total number of diesel fuel refineries in each State from a 1990 EPA survey's ratio of U.S. diesel producing refineries to total U.S. refineries. This ratio was applied to the January 1991 total number of operating refineries by State as published in the Petroleum Supply Annual (DOE, 1991).

For this analysis, EPA employed an approach that is analogous to that used in estimating the number of gasoline refineries affected under the Federal and California RFG control measures. On-road diesel fuel consumption estimates were developed for each county in the United States based on fuel economy data from EPA's MOBILE4.1 Fuel Consumption Model and county-level VMT estimates. Off-road diesel consumption was estimated by taking the ratio of 1990 NOx emissions for nonroad diesel vehicles to onroad diesel vehicles (38 percent) and applying it to county-level on-road diesel consumption. The RIA then calculated the ratio of total diesel consumed for a given NAAQS alternative to total U.S. diesel consumption (both on-road and nonroad gasoline) and applied it to the estimated total number of diesel refineries in the United States. The result is the estimated number of diesel refineries affected by the reformulated diesel program for each NAAQS alternative in this RIA. Total costs were then divided by the total estimated number of affected refineries to develop an average cost-per-establishment value for use in the cost-to-sales ratio analysis.

Recreational Vehicles: This control measure is based on a California proposal to set emission standards for off-highway motorcycles, all-terrain vehicles, golf carts, and specialty vehicles. The industries identified as impacted by this CARB-developed control measure are classified in SIC code 375 (Motorcycles, Bicycles, and Parts) and SIC code 379 (Transportation Equipment, not elsewhere classified). For this analysis, EPA employed nonattainment area-specific establishment data for these two SIC codes. As with the CARB Phase II standards, the RIA obtained establishment data from the County Business Patterns for those counties affected by the control measure. This may underestimate the number of potentially affected establishments because manufacturers located outside of the affected counties may also sell engines in nonattainment area counties that must comply with the standard. However, no information is available for improving the estimate of affected establishments at this time. Understating the number of establishments would overestimate the average cost per establishment, and, thus, would overestimate the cost-to-sales ratio impacts.

Because the two affected SIC codes include data for other transportation equipment that is not affected by this control measure (e.g., SIC code 375 includes bicycles), it was necessary to adjust the total number of establishments reported in County Business Patterns for SIC codes 375 and 379. The EPA obtained data to calculate the ratios of the national value of shipments for motorcycles to the total value of shipments for SIC code 375, and the ratio of the national value of shipments data for all-terrain vehicles, golf carts, and specialty vehicles to the total value of shipments for SIC code 3799. These data are available in the Census of Manufacturers (DOC, 1990a). By coincidence, 50 percent of SIC code 375 and 50 percent of SIC code 3799 represent the proportion of total establishments in each SIC code and nonattainment area that is affected by this measure.

Commercial Marine Vessels: The industries potentially affected by this control measure are classified in SIC codes 441 and 442 (Deep Sea Transportation of Freight) and SIC codes 443 and 444 (Other Water Transportation of Freight, including transportation along the Great Lakes-St. Lawrence Seaway and river transportation). The RIA allocated the total costs for this measure to establishments within nonattainment areas which were classified in any of these four SIC codes. Cost-to-sales ratios were then calculated for each SIC code using sales data from Enterprise Statistics (DOC, 1995a).

This control measure is based on a draft rule that was dropped from the California FIP. The draft rule included a three-tier emission fee structure based on a price of $10,000 per ton of NOx reduction. With this fee program in place, vessel operators would modify fuel combustion equipment to control the maximum amount of NOx possible as long as the cost was less than $10,000 per ton. Otherwise, vessel operators would pay the fee. Before it was dropped from the FIP, the basis for the control measure was changed. The revised measure would achieve NOx reductions by moving the shipping lane to beyond 25 miles of the Southern California coast. The cost of this shipping lane change was estimated by calculating the increased fuel costs necessary to reroute shipping travel. The shifting of shipping lanes may be a feasible control option for other areas of the country. The EPA conducted a cost-to-sales revenue analysis of this measure using ERCAM costs. The ERCAM costs reflect the $10,000 per ton cost-effectiveness number.

VIII(D) RESULTS OF IMPACTS ANALYSIS OF EACH CONTROL MEASURE

The cost-to-sales ratios in the following analyses were calculated using the incremental cost associated with each alternative relative to the current NAAQS. For each control measure-SIC code combination, the staff estimated the average annual cost per establishment for most of the control measure-SIC code combinations. Stationary area source controls may affect establishments in a number of different industries. Because of the uncertainty inherent in quantifying the number of potentially affected establishments, the average cost per establishment for stationary area sources may be over- or understated. Further, it was not possible to determine the extent to which one industry affected by a stationary area source control measure may incur higher costs than establishments in another industry affected by the same control measure. As a result, each area source control measure shows the same average cost per establishment for each affected SIC code. Some area source control measures may affect a broad range of SIC codes. For these SIC codes, calculating an average cost per establishment based on the number of establishments nation-wide would result in an underestimation of average costs per establishment. In these cases, the RIA used the methodology outlined in the previous section, which applied to all area source surface coating measures; bulk terminals; industrial adhesive; and all area source industrial fuel combustion measures. Because the cost data do not provide a method for estimating differential costs for small versus large establishments, the same average annual cost per establishment value for each control measure-SIC code combination was used for generating cost-to-sales ratios for all establishments and for small establishments. Mobile source cost-to-sales ratios do not appear in this RIA because of the degree of uncertainty associated with the methodology used to derive them.

The results of the cost-to-expenditure ratio analysis for government agencies indicated that one county agency would be potentially affected under the 8H1AX-80 alternative, and none would be affected under the other two alternatives. The SIC code for Federal agencies was identified as potentially affected under all three NAAQS alternatives. For government entities, the total cost of control measures was used to calculate cost-to-expenditure ratios rather than an average cost per establishment. The reason an average cost per establishment was not calculated for control measures affecting government agencies is that an agency would be expected to incur all costs, whereas in individual industry SIC codes, any number of different firms could share the total costs for a particular control measure-SIC code combination. Because the SBA's definition for small government entity is based on the population served, it was not possible to develop separate small entity cost-to-expenditure ratios for these control measures.

VIII(D)(1) ALTERNATIVE 8H5EX-80

The RE improvements control measure resulted in the highest point source cost-to-sales ratio at all establishments, and the glass manufacturing/oxy-firing control measure resulted in the highest ratios at small establishments. Among the area source control measures selected for meeting this alternative, the miscellaneous surface coating/add-on control levels measure is associated with the highest cost-to-sales ratio for all establishments. The paper surface coating/add-on control levels measure is associated with the highest ratio for small establishments. No county government agencies were affected by control measures selected under this alternative.

VIII(D)(2) ALTERNATIVE 8H4AX-80

As with the 8H5EX-80 standard, the stationary point source control measure accounting for the highest cost-to-sales ratio for this alternative is the RE improvements measure. The area source control measure accounting for the highest cost-to-sales ratio under this alternative is the miscellaneous surface coating/add-on control levels measure. No county government agencies were affected by control measures selected under this alternative.

VIII(D)(3) ALTERNATIVE 8H1AX-80

The impacts estimated for this alternative represent the broadest range of potentially affected SIC codes, and the highest cost-to-sales ratios. The highest cost-to-sales ratios for area source control measures are associated with add-on controls for miscellaneous surface coating. For most types of point source control measures selected under this alternative, cost-to-sales ratios are greater than 3 percent. The point source measure accounting for the highest cost-to-sales ratio for this alternative is the add-on control measure for industrial surface coating operations. Only one county government agency (i.e., Fairfax, Virginia) was identified as potentially affected by the point source wood product coating VOC control measure. Only one point source was identified as potentially being affected in the county, classified under SIC code 9223 (Correctional Institutions). The cost-to-expenditure ratio for the SIC code was zero.

VIII(E) METHODOLOGY AND LIMITATIONS OF IMPACTS ANALYSIS OF SIC CODES POTENTIALLY AFFECTED BY MORE THAN ONE CONTROL MEASURE

In addition to the analysis of the individual impacts, the RIA developed cumulative cost-to-sales ratios for SIC codes affected by more than one incremental control measure. Because the entities affected by the point source control measures are identified by a unique plant identification code in the

Interim 1990 Inventory, sufficient data were available to calculate cost-to-sales ratios for plants affected by more than one control measure. This cumulative analysis was performed on a 3-digit SIC code level, and includes only those SIC codes for which at least one plant is affected by more than one incremental control measure. The limitations discussed earlier for the point source control measures apply to the cumulative impacts analysis as well. Because specific entity information is not available for the mobile and area source control measures, it was not possible to quantify the cumulative impact of the costs associated with point source control measures and mobile/area source control measures.

For government entities affected by more than one control measure, the number of potentially affected establishments does not represent the number of individual plants affected, but indicates the number of county/Federal government agencies affected.

VIII(F) RESULTS OF IMPACTS ANALYSIS OF SIC CODES POTENTIALLY AFFECTED BY MORE THAN ONE CONTROL MEASURE

The final output of the cumulative analysis is a summary of the number of SIC codes potentially affected by the combination of overlapping point source control measures and an analysis of the proportion of these SIC codes associated with potentially significant impacts.

17 industry SIC codes are affected by more than one control measure for the 8H5EX-80 alternative, 14 of which are associated with cost-to-sales ratios of greater than 3 percent when average revenue data for small establishments are employed. The Federal government (SIC code 971-National Security) is the only government agency identified as potentially affected by more than one control measure under this alternative. Control costs were estimated for one point source establishment. The cost-to-expenditure ratio for the establishment is zero.

For the 8H4AX-80 alternative, there are 34 industry SIC codes affected by more than one control measure. The analysis indicates that 31 of these SIC codes have cost-to-sales ratios of 3 percent or greater when average small establishment revenue data are employed. The Federal government (SIC code 971-National Security) is the only government agency identified as potentially affected by more than one control measure under this alternative. Control costs were estimated for three point source establishments. The cost-to-expenditure ratio for this SIC code is zero.

78 3-digit SIC codes are affected by more than one control measure for the 8H1AX-80 ozone alternative. Employing average revenue data for small establishments, 75 of the 78 3-digit SIC codes have cost-to-sales ratios of 3 percent or greater. The Federal government (SIC code 971-National Security) is the only government agency identified as potentially affected by more than one control measure under this alternative. Control costs were estimated for eight point source establishments. The cost-to-expenditure ratio for this SIC code is zero.

VIII(G) ANALYTICAL ASSUMPTIONS AND LIMITATIONS

This analysis incorporates a number of assumptions and limitations, including:

- Analytical results reflect the costs estimated from current control strategies, not the costs from new control strategies emerging from the CAAAC FACA process.

- Data limitations prevented this analysis from differentiating between small and large entities in the application of control strategies.

- The cost inputs to the analyses have several limitations, namely:

  - detailed cost estimates were not prepared for each emissions source;

  - disaggregation to the firm level could not be performed because control cost data was only available at the establishment level;

  - cost estimates were developed using information available through 1994; recent and future developments in control through the 2007 analysis year could results in costs that are significantly lower than those utilized for this analysis;

  - this analysis does not incorporate new control strategies emerging from the FACA process or any future technological changes which may provide new or improved control measures;

  - the same average cost per establishment was used for both the economic analysis and the small entity impact analysis because sufficient data are not reported in the NPI to classify plants as small establishments; and

  - the average cost per plant shown for individual SIC codes affected by the area source fuel combustion and surface coating control measures does not differ because information is not available to identify specific costs for individual industries.

- The revenue (sales) data used in these analyses represent national averages by industry. This means that the cost/sales ratios do not accurately predict impacts on specific establishments.

- Because area and mobile sources are not individually inventoried, the actual number of establishments affected by these control measures is unknown. Generally, the number of establishments in affected counties that are reported in **County Business Patterns** was used to estimate the number of affected establishments.

- This analysis did not estimate impacts of indirectly affected sectors of the economy.

VIII(H) ENVIRONMENTAL JUSTICE ANALYSIS

Environmental justice refers to the unintentional disproportionate impact on minority and low income populations. This RIA cannot fully assess the potential for environmental justice considerations until the implementation process is completed under 40 CFR part 51.

VIII(I) GOVERNMENTAL ENTITIES IMPACT

The Unfunded Mandates Reform Act of 1995 (UMRA) requires Federal government agencies to assess the effects of Federal regulatory actions on State, local, and tribal governments (Public Law 104-4, signed March 22, 1995). Under Section 202 of UMRA, EPA must prepare a budgetary impact statement to accompany any proposed or final rule that includes a Federal mandate that may result in total estimated costs to State, local, or tribal governments of $100 million or more. Implementation of the control strategies examined may result in an aggregate annual cost of $100 million or more to State and local governments under at least one of the PM alternatives. This section of the chapter is not an unfunded mandates analysis, but does provide estimates of the potential budgetary impact of the control strategies used in the control strategy-cost analysis affecting State and local government agencies. This analysis will be useful in guiding future implementation activities, for they can direct efforts to mitigate potential negative economic impacts on governmental entities. No monitoring and administrative costs were used as inputs to estimate the impacts on governmental entities.

It is the Agency's position that once the ozone and PM NAAQS are set or revised, the States are primarily responsible for ensuring their attainment and maintenance. Under section 110 and part D of Title I of the Clean Air Act, States develop State implementation plans (SIP's) containing control measures as needed to attain and maintain a level of air quality that complies with the NAAQS. For example, in order to be in conformity with federal requirements and thereby receive federal funding, transportation control measures (TCM) cannot be federally funded or approved unless they are consistent with SIP's.

VIII(J) CONCLUSIONS

This section summarizes the results of the cost-to-sales ratio analyses presented in the previous sections. The purpose of this section is to show the relative impacts of the three ozone NAAQS alternatives relative to the current standard, to identify the control measures with the most significant impacts under each alternative, and to identify the SIC codes with the highest potentially significant impacts under each alternative.

VIII(J)(1) SUMMARY OF RESULTS

The results presented in the previous sections were used to generate Table VIII-1, which summarize the number of SIC codes with cost-to-sales ratios of 1 percent or greater, 3 percent or greater, and 10 percent or greater under each alternative. Table VIII-1 (1) provides a comparison of the occurrence of potentially significant impacts on SIC codes from one alternative to another, and (2) evaluates the effect of changing the threshold of significant impacts to a lower or higher cost-to-sales ratio.

For point sources, each potentially affected SIC code is counted as one record in the second column of Table VIII-1. For stationary area and mobile sources, it was not possible to estimate the cumulative impacts of the control measures on an SIC code because of the uncertainties involved in identifying the establishments and SIC codes affected by more than one control measure. Therefore, each area and mobile source control measure-SIC code combination which resulted in cost-to-sales ratios of 3 percent or more is counted as one record in column 2 of Table VIII-1. Based on column 2 of this table, the 8H5EX-80 alternative is associated with the least number of SIC codes/SIC code-control measure combinations with cost-to-sales ratios of 3 percent or greater (149); the 8H1AX-80 alternative is associated with the highest number of SIC codes/SIC code-control measure combinations with ratios of at least 3 percent (328).

Column 3 in Table VIII-1 presents the total number of SIC codes potentially affected by control measures under each alternative, ranging from 104 under the 8H5EX-80 alternative to 134 under the 8H1AX-80 alternative. The remaining columns in Table VIII-1 display the number of *different* SIC codes with cost-to-sales ratios of one percent or greater, three percent or greater, and ten percent or greater. These columns differ from the second column in that an SIC code is only counted once when it is potentially affected by more than one control measure. For area and mobile sources, EPA uses the control measure associated with the highest cost-to-sales ratio for these columns. For stationary point sources, the cumulative impact analysis results provide a single cost-to-sales ratio for each affected SIC code. The fifth column in Table VIII-1 shows the number of unique SIC codes for which the cost-to-sales ratio was three percent or greater. The 8H5EX-80 control measures have the least number of SIC codes (i.e., 21) with cost-to-sales ratios greater than or equal to three percent. Control measures for the most stringent alternative (8H1AX-80) have the most affected SIC codes (i.e., 64) with cost-to-sales ratios greater than or equal to three percent.

Table VIII-1 also presents the number of unique SIC codes with potentially significant impacts when cost-to-sales ratios are computed using average revenues for small establishments in an industry. Compared to the cost-to-sales ratios for all establishments, the number of unique SIC codes with a cost-to-sales ratio above a given threshold increases when computed using average revenues for small size establishments. For example, for the 8H4AX-80 alternative under a three percent threshold, the number of SIC codes increases from thirty-four to forty-two.

VIII(J)(2) KEY CONTROL MEASURES

Although the purpose of this RIA is to identify potentially affected industries for FACA purposes, this chapter also evaluates the extent to which the uncertainties in cost estimates may contribute to the high impacts. To do so, control measures that resulted in high cost-to-sales ratios under each of the three ozone NAAQS alternatives were identified. This analysis investigated control measures that consistently resulted in high cost-to-sales ratios. For each alternative, the RIA ranked control measure-SIC code combinations in descending order by the cost-to-sales ratio for all establishments. Several control measures may affect a large number of SIC codes under all of the three NAAQS alternatives. These measures include rule effectiveness improvements for VOC point sources, add-on control levels for point source industrial surface coating, and MACT-level and VOC add-on controls for miscellaneous surface coating operations

Table VIII-1
Summary of Industry Impacts

		SIC Codes						
			10 % Threshold		3% Threshold		1% Threshold	
NAAQS Alternative	3% Threshold Total SIC Code/ Code-Control Measure Combinations*	Total Number of SIC Codes Potentially Affected	Average Revenue for All Establishments	Average Revenue for Small Establishments	Average Revenue for All Establishments	Average Revenue for Small Establishments	Average Revenue for All Establishments	Average Revenue for Small Establishments
8H1AX-80	328	134	54	69	64	81	78	99
8H4AX-80	173	107	26	39	34	42	43	61
8H5EX-80	149	104	10	22	21	28	27	45

* Represents the total number of SIC codes with cost-to-sales ratios of 3% or greater that are affected by point source control measures, plus the total number of SIC code-control measure combinations with cost-to-sales ratios of 3% or greater for area and mobile source measures.

for all three alternative NAAQS. For example, RE improvements for VOC point sources affect 41 industries under the 8H1AX-80 alternative. Of this total, thirty-four industries have an average cost-to-sales ratio of 3 percent or greater when calculated for all establishments. Forty of the potentially affected industries have a small establishment average cost-to-sales ratio of 3 percent or greater. A high proportion of affected industries with cost-to-sales ratios of 3 percent or greater seems to indicate that average control costs in these industries may be unreasonably high. Further research may determine if the high impacts are associated with limitations of the methodology and/or data inputs (e.g., the average cost per plant estimate) or if further economic analyses would clarify the reasonableness of the cost-to-sales methodology for these control measures.

Another important issue related to the cost data used in this analysis is that the average cost per establishment does not always account for plant size. In other words, any economies or diseconomies of scale associated with controlling larger plants compared to controlling smaller plants are not always reflected in the cost estimate. This may, in part, explain high cost-to-sales ratios associated with many of the control measures.

VIII(J)(3) KEY SIC CODES

The RIA also used the results of the individual control measure analysis to the twenty SIC codes associated with the highest impacts under each alternative. Some SIC codes are consistently associated with very high cost-to-sales ratios, but for only one or two control measures. Other SIC codes may affect several control measures, with high expected cost-to-sales ratios for as few as one measure. The SIC codes with the highest potential for impact varies considerably between the three alternatives. For example, nine of the twenty SIC codes associated with the highest cost-to-sales ratios under the 8H1AX-80 alternative are not on the list of the SIC codes associated with the highest ratios under each of the other two alternatives. SIC codes 349 (Miscellaneous Fabricated Metal Products), 342 (Cutlery, Handtools, and Hardware), and 347 (Metal Services, not elsewhere classified) are associated with the greatest potential for impacts greater than or equal to three percent under the 8H1AX-80 alternative; SIC codes 346 (Metal Forgings and Stampings) and 342 (Cutlery, Handtools, and Hardware) have the greatest potential for impact under the 8H4AX-80 alternative; and SIC code 291 (Petroleum Refining) has the greatest potential for impact under the 8H5EX-80 alternative.

Some SIC codes are associated with only one control measure. For example, RE improvements for VOC point sources affect only the Laundry, Cleaning, and Garment Services industry (SIC code 721) under all three alternatives. In addition, some of the SIC codes appearing in these tables have only one or two plants affected. Under the 8H1AX-80 alternative, there is only one facility in the Chemicals and Allied Products industry (SIC code 516) affected by RE improvements.

Add on controls for miscellaneous surface coating measures affect many SIC codes with high cost-to-sales ratios. For example, nine of the twenty most heavily affected SIC codes are affected by this control measure under the most severe NAAQS alternative. Incremental cost-to-sales ratio analyses indicate the add-on control measure for miscellaneous surface coating operations (as well as for paper, aircraft, and marine surface coating operations) may have high cost-to-sales ratios as well.

The results of the cost-to-sales analyses were performed within a highly uncertain framework. Limitations in cost data and inventories may under or over estimate actual impacts, and this RIA cannot determine the direction or magnitude of that difference. Additionally, some results appear excessive due to possible mis-coding within Census data or because some data came from regional information which may not be representative of a national value. For example, the cost-effectiveness value used to estimate costs[8] is based on the cost-effectiveness of add-on controls for a wood product coating rule developed by the South Coast Air Quality Management District in California. According to the South Coast Air Quality Management District, wood product coating facilities were expected to comply with the stringent limits of the rule by the use of reformulated coatings at a cost effectiveness of $20/ton. Consequently, there may be considerable uncertainty in using the $9,630/ton cost-effectiveness value to estimate the cost of controls for small miscellaneous, paper, aircraft, and marine surface coating operations in the area source inventory. Further research would be needed to determine how representative the cost-effectiveness value is for estimating control costs for these operations.

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8 $9,630/ton of VOCs reduced from uncontrolled levels

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IX BENEFITS OF OZONE NAAQS ATTAINMENT

IX(A) ECONOMIC CONCEPT OF BENEFITS

One rationale for environmental regulation, such as this National Ambient Air Quality Standard for ozone, is to provide benefits to society by enhancing (improving and protecting) human health and overall public welfare. This chapter provides information on the types and levels of social benefits anticipated from the proposed rulemaking. This information includes: (1) background information on benefits assessment, by describing benefit categories and issues in benefits estimation; (2) qualitative descriptions of the types of benefits associated with four ozone NAAQS alternatives; (3) quantitative estimates of benefit categories for which concentration-response information is available; and (4) monetized estimates of benefit categories for which economic valuation data are available.

IX(A)(1) BENEFIT CATEGORIES APPLICABLE TO THE REGULATION

To implement a benefit analysis, the types or categories of benefits that apply need to be defined. Figure IX-1 provides an example of the types of benefits potentially observed as a result of changes in air quality. The types of benefits identified in both the health and welfare categories can generally be classified as *use benefits* or *non-use benefits.*

FIGURE IX-1
EXAMPLES OF POTENTIAL BENEFITS OF AIR QUALITY IMPROVEMENTS

USE BENEFITS	EXAMPLES
Direct	*Human Health Risk Reductions (e.g., less incidences of coughing) *Increased Crop Yields
Indirect	*Non-Consumptive Use (e.g., improved visibility for recreational activities)
Option Value	*Risk Premium for Uncertain Future Demand *Risk Premium for Uncertain Future Supply (e.g., treating as insurance, the protection of a forest just in case a new use for a forest product will be discovered in the future)
Aesthetic	*Residing, working, traveling, and/or owning property in reduced smog locations
NON-USE BENEFITS	
Bequest	*Intergenerational Equity (e.g., an older generation wanting a younger generation to inherit a protected environment)

Existence	*Stewardship/Preservation/Altruistic Values (e.g., an individual wanting to protect a forest even if he knows that he will never use the forest) *Ecological Benefits

Use benefits are the values associated with an individual's desire to avoid his or her own exposure to an environmental risk. Use benefit categories can embody both direct and indirect uses of affected ambient air, and the direct use category embraces both consumptive and nonconsumptive activities. In most applications to air pollution scenarios, the most prominent use benefit categories for air are those related to human health risk reductions, effects on crops and plant life, visibility, and materials damage.

Non-use (intrinsic) benefits are values an individual may have for lowering air pollution concentrations or the level of risk unrelated to his or her own exposure. Improved environmental quality can be valued by individuals apart form any past, present, or anticipated future use of the resource in question. Such nonuse values may be of a highly significant magnitude; however, the benefit value to assign to these motivations often is a matter of considerable debate. Whereas human uses of a resource can be observed directly and valued with a range of technical economic techniques, nonuse values can only be ascertained from directly asking survey respondents to reveal their values.

Non-use values may be related to the desire to know that a clean environment be available for the use of others now and in the future, or may be related to the desire to know that the resource is being preserved for its own sake, regardless of human use. The component of non-use value that is related to the use of the resource by others in the future is referred to as the bequest value. This value is typically thought of as altruistic in nature. For example, the value that an individual places on reducing the general population's risk of ozone exposure either now or in the future is referred to as the bequest value. Another potential component of non-use value is the value that is related to preservation of the resource for its own sake, even if there is no human use of the resource. This component of non-use value is sometimes referred to as existence value.
An example of an existence value is the value placed on the ecological benefit of protecting areas know as wetlands because they play a crucial role in our ecological system, even if the wetlands themselves are not directly valued by humans. A key distinction between bequest value and existence value is that bequest values are anthropocentric while existence values are viewed by some as completely distinct from human valuation.

The majority of health and welfare benefit categories presented in this analysis can be classified as direct use benefits. These benefits are discussed in greater detail compared to other benefit categories presented in Figure IX-1 because more scientific and economic information has been gathered for the direct use benefit category. For example, scientific studies have been conducted to discern the relationship between ozone exposure and subsequent effects on specific health risks and agricultural commodities. In addition, economic valuation of these benefits can be accomplished because a market exists for some categories (making it possible to collect supply, demand, and price information) or contingent valuation studies have been conducted for categories that people are familiar with (such as willingness-to-pay surveys for non-market commodities).

Detailed scientific and economic information is not as readily available for the remainder of the benefit categories listed in Figure IX-1. Information pertaining to indirect use, option value, aesthetic, bequest, and existence benefits is often more difficult to collect. For example, lowering ambient ozone concentrations in an area is expected to improve visibility in the affected area while also reducing physical damage to ornamental plants in the same area. A homeowner living in the affected area with ornamental plants in his yard is expected to benefit from the improved visibility while his plants may experience either an improved appearance or an extended life. Although scientific information can help identify the benefit categories of improved visibility and decreased damage to urban ornamentals, lack of more detailed scientific information (e.g., concentration-response relationships for urban ornamentals) or economic information (e.g., how much value a homeowner places on improved visibility in his neighborhood or city) prevent further quantification of these benefit categories.

Another problem related to lack of information is the ability to identify all benefit categories that might result from environmental regulation. A cost analysis is expected to provide a more comprehensive estimate of the cost of an environmental regulation because technical information is available for identifying the technologies that would be necessary to achieve the desired pollution reduction. In addition, market or economic information is available for the many components of a cost analysis (e.g., energy prices, pollution control equipment, etc.). A similar situation typically does not exist for estimating the benefits of environmental regulation. The nature of this problem is due to the non-market characteristic of many benefit categories. Since many pollution effects (e.g., adverse health or agricultural effects) have not traditionally been traded as a market commodity, economists and analysts have had to rely upon scientific and economic theory to identify relevant benefit categories. This lack of observable markets may lead to the omission of significant benefit categories from an environmental benefits discussion.

The inability to quantify the majority of the benefit categories listed in Figure IX-1 as well as the possible omission of relevant environmental benefit categories will cause the quantified benefits presented in this report to clearly be underestimated. Due to the lack of information, it is not possible to estimate the magnitude of the benefits that have been unquantified.

IX(A)(2) ECONOMIC BENEFITS

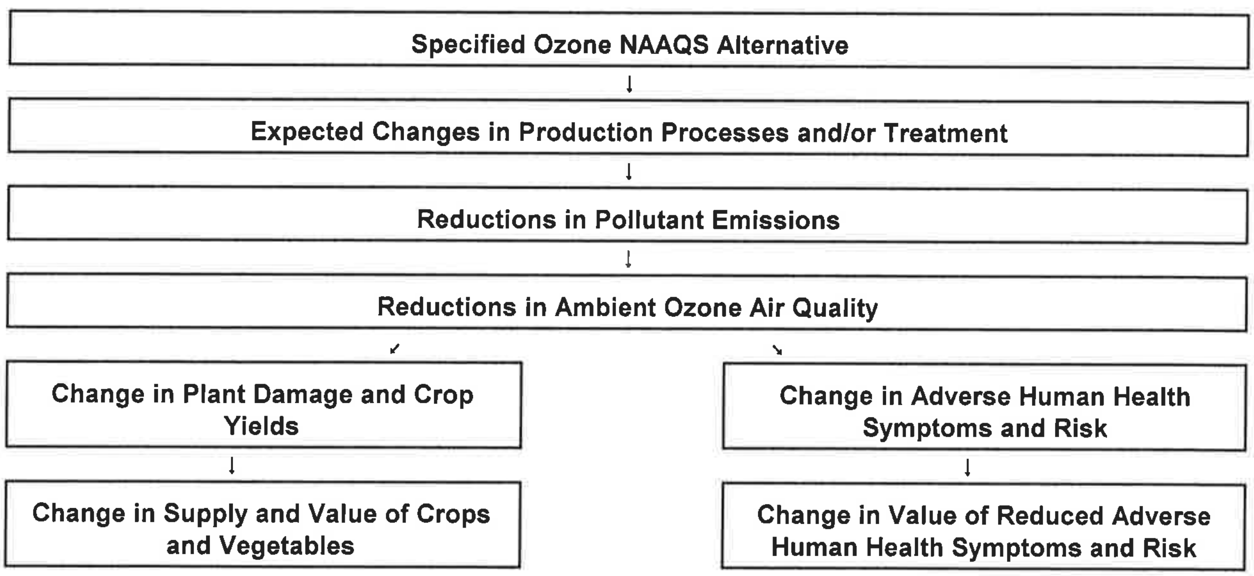
The general term "benefits" refers to any and all outcomes of the regulation that are considered positive; that is, that contribute to an enhanced level of social welfare. The term "economic benefits" refers to the dollar value associated with all the expected positive impacts of the regulation; that is, all regulatory outcomes that lead to higher social welfare. Conceptually, the monetary value of benefits is approximated by the sum of the predicted changes in "consumer (and producer) surplus." These "surplus" measures are standard and widely accepted terms of applied welfare economics, and reflect the degree of well-being enjoyed by people given different levels of goods and prices (including those associated with environmental quality).

This conceptual economic foundation raises several relevant issues and potential limitations for the benefits analysis of the regulation. First, the standard economic approach to estimating environmental benefits is anthropocentric - all benefit values arise from how environmental changes are perceived and valued in present-day values. Thus, all near-term as well as temporally distant future physical outcomes associated with reduced pollutant loadings need to be predicted and then translated into the framework of present-day human activities and concerns.

IX(A)(3) LINKING THE REGULATION TO BENEFICIAL OUTCOMES

Conducting a benefits analysis for anticipated changes in air emissions is a challenging exercise. Assessing the benefits of a regulatory action requires that a chain of events be specified and understood. As shown in Figure 2, which illustrates the causality for air quality related benefits, these relationships span the spectrum of: (1) institutional relationships and policy-making; (2) the technical feasibility of pollution abatement; (3) the physical-chemical properties of air pollutants and their consequent linkages to biologic/ecologic responses in the environment, and (4) human responses and values associated with these changes.

FIGURE IX-2
EXAMPLE METHODOLOGY OF A BENEFITS ANALYSIS



The first two steps of Figure IX-2 reflect the institutional and technical aspects of implementing the regulation (the improved process changes or pollutant abatement). The benefit analyses presented in this document begin at the step of estimating reductions in ambient ozone air quality. In this analysis, lack of a national ozone air quality model precludes creating a direct link between the imposition of pollution control equipment (as identified in the cost analysis) and the resulting ambient ozone concentration. Rather, this analysis relies on a rollback methodology that reduces hourly ozone concentrations from two different baselines in the year 2007: one referred to as the regional control strategies baseline and one referred to as the local control strategies baseline. Chapter IV of this report presented the methodology used to estimate baseline ambient ozone air quality in the year 2007.

This RIA also presents two scenarios for analyzing reductions in ambient ozone air quality. The first, referred to as the full attainment scenario, relies on the assumption that all areas will be able to attain any ozone NAAQS being evaluated. The health and welfare benefits presented under this scenario represent the identifiable benefits that should accrue if all areas in the United States could comply with the standard being analyzed. The second scenario, referred to as the partial attainment scenario, is intended to reflect residual nonattainment information as presented in the cost analysis. For each area identified as not having sufficient control measures to allow it to attain a particular standard, the rollback methodology has been scaled proportionally. The scaling of the rollback methodology is intended to reflect the degree of nonattainment for each residual nonattainment area. The health and welfare benefits presented under this partial attainment scenario represent the identifiable benefits that should result from the application of control measures as identified in the cost analysis. Note that the benefits presented for the full attainment scenario will always exceed the benefits presented for the partial attainment scenario since the partial attainment scenario accounts for residual nonattainment. Chapter 5 presented the methodology used to estimate ozone concentrations for the partial attainment scenario.

Other information necessary for these benefit analyses are the physical and chemical parameters and the consequent improvement in the environment (e.g., concentration-response data). Finally, the analysis reaches the stage at which anthropocentric benefit concepts begin to apply, such as illustrated by reductions in human health risk and improvements in crop yields. These final steps reflect the focal point of the benefits analyses, and are defined by the benefits categories described above. Below, relevant benefit categories are described qualitatively, and where possible, quantitatively.

IX(B) HUMAN HEALTH EFFECTS

This health benefits analysis estimates that incremental to the current NAAQS, full attainment of the proposed ozone NAAQS will yield annual monetized health benefits in the range between $4 million and $2.3 billion. Adjusting the health benefit estimates to reflect the presence of residual nonattainment, the annual monetized health benefits are expected to range between $2 million and $1.2 billion. The health benefit categories examined in this analysis and the methodology used to estimate the monetized health benefits are presented below.

IX(B)(1) INTRODUCTION

This section presents a qualitative description of the documented human health effects associated with exposure to ozone. The proposed ozone NAAQS is expected to further reduce emissions of volatile organic compounds (VOCs) and nitrogen oxides (NO_x). The reaction of these pollutants in the ambient air in the presence of sunlight and heat results in the formation of ozone. As discussed below, exposure to ozone can result in a variety of adverse health effects[1] Numerous and diverse health effects have been linked to ozone exposure in laboratory experiments, including lung inflammation, effects on lung host defense mechanisms, morphological (lung structure) effects, respiratory symptoms, pulmonary function decrements, changes in lung biochemistry, and genotoxicity (cellular transformation effects). Although these effects each have different physiological mechanisms, each effect is initiated by the preliminary interactions of ozone and ozone-reaction products with fluids and epithelial cells in the respiratory tract.

These health effects have been attributed to short-term (1 to 3 hours), prolonged (6 to 8 hours), and long-term (months to years) exposures to ozone. Adverse health effects which have been attributed to exposure to ambient ozone include: transient changes in pulmonary function, transient respiratory symptoms and effects on exercise performance, increased airway responsiveness, transient pulmonary inflammation, increased susceptibility to respiratory infection, increased hospital admissions and emergency room visits, reduced worker productivity, and possibly, premature mortality. Short-term effects are observed at ozone concentrations as low as .12 ppm, while similar health effects have been observed following prolonged exposures to ozone at ozone concentrations as low as .08 ppm (i.e., at lower levels of exercise than for short-term exposures.) For a detailed discussion of adverse human health effects associated with ozone exposure, refer to the ozone Criteria Document and Staff Paper .

The human health effects that will be quantified (expressed in terms of incidences reduced) and sometimes monetized (expressed in terms of dollars) are presented in Table IX-1. These health effects include: change in forced expiratory volume (DFEV); lower respiratory symptoms; coughs; pain upon deep inhalation; mortality; hospital admissions for all respiratory illnesses, pneumonia, and chronic obstructive pulmonary disease (COPD); the presence of any of 19 acute respiratory symptoms; self-reported asthma attacks; restricted activity days; sinusitis and hay fever; worker productivity; and development of definite asthma.

A number of community epidemiology studies have suggested a possible association of ozone or oxidants with mortality. Early studies of this issue were flawed, but more recent work provides some additional insights. Several recent studies of daily mortality have included ozone, either alone or in combination with PM and other pollutants. These studies are summarized in the Particulate Matter Criteria Document (PM CD). The PM CD includes studies in New York City (Thurston and Kinney, 1995), Philadelphia (Moolgavkar et al., 1995; Samet et al., 1996; and Cifuentes and Lave, 1996) Los Angeles (Kinney et al., 1995), and Toronto, Canada (Ozkaynak et al., 1994). Each of these studies found evidence of associations between ozone and daily mortality that was statistically significant or nearly significant. The relative strength and consistency for ozone mortality relationships, however, varied among different model specifications and co-pollutants included. Until a more complete assessment of those emerging studies can be conducted, the evidence is sufficient to estimate an ozone-induced mortality benefit.

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[1]See the Ozone Staff Paper an the Ozone Criteria Document for more detailed discussions of the health effects listed in this report.

In addition to the studies above, Kinney and Ozkaynak (1991) reanalyzed earlier data concluding that ozone explained a small but statistically significant portion of daily mortality in Los Angeles. A study in eastern Tennessee of limited duration and lower ozone levels found no ozone association (Dockery, 1992). The ozone criteria document review of the literature concluded that although an association existed between high ozone levels and mortality has been suggested, the strength of any such association remains unclear. A more recent assessment of these and other studies for the purpose of conducting benefit assessments for the UN ECE provided a range of estimates for ozone-mortality of 0.01 to 0.02% per ppb ozone (EFTEC Ltd., 1996). The issue of the relative role of ozone and PM in mortality studies has been raised in the context of the particulate matter criteria review, particularly in two recent studies of Philadelphia daily mortality by Moolgavkar et al. and HEI (Samet et al.). These studies have raised the observation by some that although particulate matter may be a better surrogate for air pollution that appears to be causing increased mortality, it is difficult to single out any one pollutant as wholly responsible for all of the observed effects. In the HEI study of daily mortality, ozone appeared to be separable from a group of other pollutants that contained PM. Although the Agency recognizes that a high degree of uncertainty exists in the estimation of ozone-induced mortality, the evidence linking a causal relationship between ozone exposure and mortality is significant enough in these new studies to warrant inclusion of this category in this analysis. Because benefit functions from the recent Moolgovkar study are readily available, the staff chose to use the function derived from that study to derive an estimate for use in the upper bound of the range of benefit estimates. A complete discussion of how mortality was included in these estimates appears in the aggregation section of this chapter.

All categories of health benefits listed in Table IX-1 that are monetized are also quantified. However, some categories of benefits that are quantified have not been monetized due to one of two reasons: (1) because willingness-to-pay values are not available or (2) to prevent double-counting some overlapping effects. These issues are discussed in greater detail further in this chapter. For categories of health benefits listed as unquantified, scientific data is not available for quantifying the relationship between ozone and incidences of each symptom. However, the Criteria Document and Staff Paper present scientific evidence supporting an association between these health effects and ozone exposure. For example, the collective toxicologic data on chronic exposure to ozone garnered in animal exposure and human population studies provide a biologically plausible basis for considering the possibility that repeated inflammation associated with exposure to zone over a lifetime may result in sufficient damage to respiratory tissue such that individuals later in life may experience a reduced quality of life. However, such relationships remain highly uncertain due to ambiguities in the data.

TABLE IX-1
HEALTH BENEFIT CATEGORIES

Unquantified Health Benefit Categories [1]	Quantified Benefit Categories [2] (in terms of incidences reduced only)	Monetized Benefit Categories [3] (in terms of dollars)

Airway responsiveness Pulmonary inflammation Increased susceptibility to respiratory infection Acute inflammation and respiratory cell damage Chronic respiratory damage/Premature aging of lungs	DFEV (change in forced expiratory volume) Restricted activity days Lower respiratory symptoms	Coughs Pain upon deep inhalation Mortality Hospital admissions for all respiratory illnesses Hospital admissions for pneumonia Hospital Admissions for chronic obstructive pulmonary disease (COPD) Presence of Any of 19 Acute Respiratory Symptoms Self-Reported Asthma Attacks Worker Productivity

1 Unquantified health benefit categories are described at length in the Ozone Staff Paper and Criteria Document.
2 Quantified health benefit categories are described at length in the Ozone Staff Paper and Criteria Document and are estimated in terms of incidences reduced in this RIA.
3 Monetized health benefit categories are described at length in the Ozone Staff Paper and Criteria Document, are estimated in terms of incidences reduced in this RIA, and are monetized in this RIA.

The result of having significant gaps in the benefits calculations leads to an underestimation of the monetized benefits presented in this report. The effect of the underestimation is to severely limit any conclusions that can be reached regarding the monetized benefits and net benefit estimates of each of the alternative ozone NAAQS.

IX(B)(2) QUANTIFIED HEALTH EFFECT BENEFITS

IX(B)(2)(a) TYPES OF HEALTH STUDIES

Scientific research about ozone's adverse health impacts uses a broad array of methods and procedures. The research methods used to investigate the health effects of ozone have become considerably more sophisticated over time and will continue to evolve in the future. This progress is the result of better available research techniques and data, and the ability to focus further research more sharply on key remaining issues based on the contributions of earlier work.

The available health effects studies that are being used as the basis of this health benefits assessment are divided into two categories: (1) human clinical studies and (2) epidemiology studies. Epidemiological research in air pollution investigates the association between exposure to air pollution and observed health effects in the study population. Human clinical studies involve examination of human responses to controlled conditions in a laboratory setting. EPA has conducted research on health effects from exposure to pollution using each approach, and studies using these techniques have been considered in various formal regulatory proceedings. Each type of study (as it is used for air pollution research) is described below.

IX(B)(2)(b) HUMAN CLINICAL STUDIES

Clinical studies of air pollution involve exposing human subjects to various levels of air pollution in a carefully controlled and monitored laboratory situation. The physical condition of the subjects is measured before, during, and after the pollution exposure. The measured physical condition can include general biomedical information (e.g., pulse rate and blood pressure), physiological effects specifically affected by the pollutant (e.g., lung function), the onset of symptoms (e.g., wheezing or chest pain), or the ability of the individual to perform specific physical or cognitive tasks (e.g., maximum sustainable speed on a treadmill). These studies often involve exposing the individuals to pollutants while exercising, thus increasing the amount of pollutants that are actually introduced into the lungs.

Clinical studies can isolate cause-effect relationships between pollutants and certain human health effects. Repeated experiments altering the pollutant level, exercise regimen duration and types of participants can potentially identify effect thresholds, the impact of recovery (rest) periods, and the differences in response among population groups. While cost considerations tend to limit the number of participants and experimental variants examined in a single study, clinical studies can follow rigorous laboratory scientific protocols, such as the use of placebos (clean air) to establish a baseline level of effects and precise measurement of certain health effects of concern.

There are drawbacks to using clinical studies as the basis for a comprehensive benefits analysis. Clinical studies are appropriate for examining acute symptoms caused by short-term exposure to a pollutant. While this permits examination of some important health effects from air pollution, such as asthma attacks caused by sulfur oxides, it excludes studying more severe effects or effects caused by long term exposure. Another drawback is health effects measured in some well-designed clinical studies are selected on the basis of the ability to measure precisely the effect rather than a larger symptom, for example forced expiratory volume. The impact of some clinically measurable health effects such as lung function on future medical condition or lifestyle changes are not well understood.

Ethical limits on experiments involving humans also impose important limits to the potential scope of clinical research. Chronic effects cannot be investigated because people cannot be kept in controlled conditions for an extended period of time, and because these effects are generally irreversible. Participation is generally restricted to healthy subjects, or at least to exclude people with substantial health conditions that compromise their safe inclusion in the study. This methodology can cause clinical studies to avoid providing direct evidence about populations of most concern, such as people who already have serious respiratory diseases. Ethical considerations also limit the exposures to relatively modest exposure levels, and to examining only mild health effects that do no permanent damage. Obviously for ethical reasons, human clinical evidence cannot be obtained on the possible relationship between pollution and mortality, heart attack, stroke, or cancer.

The precision to which exposure conditions are controlled in clinical studies also creates an obstacle to using clinical dose-response functions for benefit analysis. It is difficult to extrapolate results from clinical settings to daily exposures faced by the whole population. For example, many clinical studies evaluate effects on exercising individuals. Only a small portion of the population engages in strenuous activity (manual labor or exercise) at any time. Reflecting these fundamental differences between the laboratory setting and the "real world" imposes a formidable burden on researchers to provide information about human activity patterns, exercise levels, and pollution levels.

IX(B)(2)(c) EPIDEMIOLOGICAL STUDIES

Epidemiological studies evaluate the relationship between ambient exposures to and health effects in the human population, typically in a "natural" setting. Statistical techniques (typically variants of multivariate regression analysis) are used to estimate quantitative concentration-response relationships between pollution levels and health effects.

Epidemiology studies can examine many of the types of health effects that are difficult to study using a clinical approach. Epidemiological results are well-suited for quantitative benefit analyses because they provide a means to estimate the incidence of health effects related to varying degrees of ambient air pollution without further extensive modeling effort. These estimated relationships implicitly take into account at least some of the complex real-world human activity patterns, spatial and temporal distributions of air pollution, synergistic effects of multiple pollutants and other risk factors, and compensating or mitigating behavior by the subject population. Suspected relationships between air pollution and the effects of both long-term and short-term exposure can be investigated using an epidemiological approach. In addition, observable health endpoints are measured, unlike clinical studies which often monitor endpoints that do not result in observable health effects (e.g., forced expiratory volume). Thus, from the point of view of conducting a benefits analysis, the results of epidemiological studies, combined with measures of ambient pollution levels and the size of the relevant population, provide all of the essential components.

Two types of epidemiological studies are considered for dose-response modeling: cohort and longitudinal studies. Cohort-based studies are population-based studies where initially disease free individuals are followed over a certain period of time, with periodic reporting of the health status from the individuals. Studies about relatively rare events such as cancer incidence or mortality can require tracking the individuals over a long period of time, while more common events (e.g., respiratory symptoms) occur with sufficient frequency to evaluate the relationship over a much shorter time period. An important feature of cohort studies is that information is known about each individual, including other potential variables related to the disease being studied. These variables, called confounders, are important to identify because if they are not accounted for in the study and they are associated with air pollution levels, a biased estimate of air pollution to human health may be estimated. The exposure information can range from data from a personal exposure monitor carried by the participants for a few weeks in a study concerning minor symptoms, to monitoring data of ambient air concentrations.

A second type of epidemiological study is the longitudinal or time-series studies. The relationship between population-wide health information such as counts for daily mortality, hospital admissions, or emergency room visits (e.g., heart attack, mortality, acute asthma attack or chronic bronchitis) and ambient levels of air pollution are evaluated. One advantage of this study design is it allows "the population to serve as its own control". Changes in such factors as tobacco, alcohol and illicit drug use, access to health care, employment, and nutrition may have a pronounced impact on the health of an individual, and, if they vary with the pollution variable of interest, need to be included in a cohort study. However, such potential confounding factors are unlikely to vary with pollution levels and these variables do not need to be evaluated in the analysis.

Some of the drawbacks of epidemiological research are: (1) it is difficult to adequately characterize exposure; (2) measurement errors may occur in the explanatory variables; (3) the influence of unmeasured variables; and (4) correlations between the pollution variables of concern and other variables (both the included and omitted variables). These factors can potentially lead to spurious conclusions. However, epidemiological studies involve a large number of people and do not suffer extrapolation problems like clinical studies.

IX(B)(3) HEALTH BENEFITS METHODOLOGY

Due to the advantages and disadvantages of both clinical and epidemiological studies, this analysis uses health effects data from both types of studies to estimate the potential health-related benefits of the ozone NAAQS. This approach allows a broader range of scientific evidence to be used to estimate the potential health benefits. However, as explained above, the types of health effects examined in each type of study are not comparable. For example, an epidemiological study might attempt to estimate the number of hospital admissions that occur for the treatment of respiratory symptoms compared to a clinical study that might attempt to estimate the number of coughs that are elicited from a specific exposure incident. For this reason, the results from the epidemiological and clinical approaches must be considered as alternative approaches for estimating the health-related benefits of the ozone NAAQS rather than as two approaches with results that can be combined.

For this analysis, the choice of the health effects modeled were as inclusive as possible. Since ozone is associated with a variety of health effect endpoints, the effects may overlap with each other, as described below. Despite this overlap, the analysis presents separate estimates of incidences for all health effects.

IX(B)(3)(a) BASELINE OF ANALYSIS

As discussed earlier in this report, air quality data have been generated for two baseline scenarios in the year 2007. The first baseline scenario is referred to as regional control strategies while the second scenario is referred to as local control strategies. Although benefit estimates are estimated from both baseline scenarios, the EPA expects the regional control strategies scenario to represent the more realistic air quality baseline for the year 2007.

IX(B)(3)(b) OZ-ONE

OZ-ONE is the computer model used in this report to estimate health effects changes and the associated economic benefits due to estimated changes in ambient ozone. This program generates ozone concentration data for a baseline situation as well as an estimate of post-rollback ozone concentrations. The air quality methodology using the centroid approach (as described in chapter 6 of this report) identified baseline ozone air quality in the year 2007. In addition, chapter 6 identified predicted ozone nonattainment areas for each alternative ozone NAAQS analyzed in this report. The quadratic roll-back methodology was then employed to estimate post-rollback ambient ozone concentrations for each of the nonattainment areas under each of the alternative ozone NAAQS scenarios.

Lack of the use of an air chemistry model necessitates the development of a methodology to estimate changes in air quality. The application of quadratic rollback attempts to estimate reductions in ozone concentrations, given that control measures are expected to be applied in nonattainment areas.

Although the choice of a rollback methodology is expected to affect the calculation of benefits (the number adverse incidences avoided is influenced by the estimate of the change ozone air quality) an analysis of the difference in impacts between various rollback methodologies (e.g., quadratic, peak-shaving, linear) has not been performed for this analysis.

The risk assessment conducted for the Ozone Staff Paper used a Weibull distribution to roll back ozone air quality concentrations. The Weibull distribution is data intensive because it relies on historical air quality data specific to geographical regions. The data-intensive nature of this work is one of many reasons why the Staff Paper only analyzed health risks in nine case-study cities. One goal of this RIA is to conduct a benefits analysis on a national scope for the year 2007. Lack of historical data on a geographical region for the analysis year requires a more generalized approach for estimating air quality changes. This requirement led to the development of the quadratic rollback methodology. (Mathtech, 1996a).

The ozone nonattainment areas analyzed in this health benefits analysis are the same as the nonattainment areas examined in the cost analysis, with one exception - areas identified as "marginal" nonattainment areas. Current implementation guidelines require increasingly stringent control measures as the degree of nonattainment increases. Marginal nonattainment areas fall within the range closest to attainment. These marginal areas are not expected to be required to implement control measures in order to bring themselves into attainment. Rather, the Agency expects that these areas will implement less costly administrative measures (e.g., performing quality assurance checks on their inventory information) to achieve attainment. The cost analysis in this RIA does not estimate the administrative costs associated with these marginal areas although the Agency expects these costs to be relatively low. However this benefits analysis applies quadratic roll-back to <u>all</u> identified ozone nonattainment areas, including those labeled as marginal, because implementation of the ozone NAAQS will include requirements for all nonattainment areas to comply with the NAAQS.

In addition to processing air quality data, OZ-ONE evaluates a variety of health effects that are associated with ozone exposure. OZ-ONE evaluates the health effects under the 2007 baseline and post-rollback ozone scenarios (assuming that all identified nonattainment areas fully comply with each of the alternative ozone NAAQS being evaluated). The change in the number of effects (e.g., the number of cough incidences) represents the basic output of the OZ-ONE program. Therefore, the health effects estimates presented later in this chapter represent the difference in the number of health incidences that are expected to occur between the baseline and post-rollback ozone air quality.

IX(B)(4) HEALTH EFFECTS MODELS

IX(B)(4)(a) CLINICAL AND EPIDEMIOLOGICAL MODELS

The goal of this phase of the analysis is to estimate expected changes in the number of cases of different health endpoints as ozone concentrations change in response to the implementation of alternative ozone NAAQS.

Table E-1 in Appendix E lists the clinical models used in this analysis. This table provides author information for each clinical model included in this analysis. Health endpoints evaluated by the clinical models include: change in forced expiratory volume (DFEV) of $\geq$10%, $\geq$15%, $\geq$20%; lower respiratory symptoms; cough; and pain upon deep inhalation. A review of these models is not included in this report because an evaluation of each model is provided in the Ozone Staff Paper's Risk and Exposure Analysis.

Each clinical model identifies the change in health effect as a rate; for example, as a per capita value. In order to identify the aggregate population impact, it is necessary to specify the population affected. The clinical analysis evaluates the concentration-response functions for two sub-population groups: outdoor children and outdoor workers. These results are then summed to provide a total estimate of benefits of ozone control. This methodology is consistent with the methodology used in the risk and exposure analysis conducted for the Ozone Staff Paper.

Table E-2 in Appendix E lists the epidemiological models that are used in this analysis. This table provides author information for the 18 epidemiological models used in this analysis. Health endpoints evaluated by these models include: mortality, hospital admissions for a variety of conditions, the presence of acute respiratory symptoms, self-reported asthma attacks, minor restricted activity days (MRADs), respiratory restricted activity days (RRADs), sinusitis and hay fever, development of definite asthma, and worker productivity (resulting in changes in daily wages). A review of these models is not provided in this report because all of these models were previously evaluated in the Section 812(a) draft report. Therefore, the reader should consult the Section 812 (a) draft report for a more detailed discussion of these models.

Each epidemiological model identifies the change in health effect as a rate; for example as a per capita value. In order to identify the aggregate population impact, it is necessary to specify the population affected. The population data is location specific (i.e., the population is specific to each MSA) and reflects the population included within the study parameters of the epidemiological model. For example, if a particular model is identified only with individuals over 65 years of age, then the prediction of impacts is limited to that population group. Extrapolation to other age groups presumes that age does not matter for purposes of evaluating the effects of ozone. This assumption does not appear to be credible for many of the health end-points considered in this analysis since age appears to be a significant variable in many studies.

Under each approach, the concentration-response function, the air quality data, and the population information are applied in the following procedure: Each model is evaluated with the nonattainment area-specific ozone data (baseline and post-attainment) in order to predict per capita changes in the associated health endpoint. These changes in per capita health impacts are then multiplied by the appropriate population count to obtain a measure of the expected change in impacts for a specific geographic area. However, adjustments to the time period of analysis and the count of incidences are made before the results are reported as health benefits on a national basis.

IX(B)(4)(b) TIME PERIOD OF ANALYSIS

To ensure additional consistency with the risk and exposure analysis, two additional adjustments were made to the clinical studies. Activity pattern factors (i.e., the amount of time people spend outdoors, indoors, etc.) from the risk and exposure analysis were incorporated into the OZ-ONE program. These activity pattern data were only available for the ozone season. Although the ozone season varied from area to area, the "season" was significantly less than a full calendar year in the majority of areas. Since the activity pattern factors were an integral component of the health benefits calculation, it was necessary to limit the calculation of the clinical health benefits to each nonattainment MSA's ozone season. (See the Ozone Staff Paper)

An area's ozone season is the period of time during a year when the potential for high ozone concentrations is greatest. Given that the concentration-response functions predict a greater number of health incidences given higher ozone concentrations, it is likely that the ozone season will provide the majority of the number of incidences expected to occur during a year. In addition, any action that would decrease an area's ozone concentration would be expected to produce the greatest health benefits during the ozone season compared to any other time of year. Therefore, the evaluation of the clinical concentration-response functions during an area's ozone season is expected to capture the majority of the health benefits expected to occur during a full calendar year.

Unlike the clinical studies, the epidemiological studies are designed to examine human health effects in a "natural" setting. As such, information such as human activity patterns and exercise levels are assumed to be built into the concentration-response relationship. Thus, the activity pattern data need not be incorporated into the epidemiological models. Since all information used to evaluate the epidemiological models were available for a full calendar year, the epidemiological model results represent results for the entire year in 2007.

IX(B)(4)(c) INCIDENCES VERSUS INCIDENCE-DAYS

When evaluating the clinical studies, OZ-ONE provides an estimate of the number of times (incidences) that a health symptom would occur over a 16-hour day (8 am to 12 am) during an MSA's ozone season. However, dollar estimates from the contingent valuation (CV) surveys that are used to estimate the economic value of these health effects are estimated in terms of dollars per avoided "symptom day." For example, evaluation of a clinical coughing model over a 16-hour day would yield the total number of times a cough is expected to occur during this time period given a particular level of ambient ozone. This estimate does not differentiate between multiple coughs experienced by one person versus one cough experienced by many people. Moreover, the definition of a symptom day does not appear to be well defined in the CV studies. Lacking further information, this analysis will define a symptom day as "...the value of avoiding a symptom experienced over one day."

Due to the definition of a symptom day as reported in the contingent valuation surveys, it is necessary to convert the number of incidences of a health symptom into a comparable count of the number of symptom days. This conversion is accomplished by applying each clinical concentration-response function to the daily two-hour period (or other relevant time period, as defined by each model) reported as having the highest ambient ozone concentration during that day. This time period corresponds to the highest probability of response among the affected population for that day and as such, this daily period will capture the maximum number of people that would experience a health symptom as a result of ozone exposure if activity patterns were constant across the day. Where available, activity pattern information was used in conjunction with ozone concentration data to identify the two-hour period (or other relevant time period) of each day that would provide the greatest impact. This period was then used to define the "incidence-day" (i.e., symptom day) value for each concentration-response model. Therefore, the results (labeled incident-days) presented for the clinical models represent values for only one two-hour period (or other relevant time period) of each day during an area's ozone season.

The above methodology is not concerned with the total number of incidents which would result from ambient ozone exposure. Instead, it is only concerned with the count of days over the affected population in which incidents occur. A person experiencing multiple incidents during the same day is classified as experiencing one incident day, thereby avoiding double-counting and adhering to the format of the contingent valuation estimates.

Unlike the clinical studies, the results of the epidemiological studies are expressed in the same units as the contingent valuation studies. For example, one epidemiological study included in this analysis estimates the number of pneumonia-related hospital admissions that are expected to occur given a particular level of ambient ozone. In this case, the results would be expressed in terms of incidences of hospital admissions. The contingent valuation estimates used to value this benefit category are expressed in dollars per incident avoided. Thus, no adjustments need to be made to the calculation of the epidemiological results.

IX(B)(4)(d) AGGREGATION BY HEALTH ENDPOINT

This section describes the methodology used to aggregate results within each health endpoint category since the majority of the health endpoints evaluated in this analysis have more than one model to provide estimates of the number of incidences of a health effect. In addition, multiple models evaluate varying degrees of the same health endpoint (*coughing incidences* and *moderate to severe coughing incidences*).

The clinical models included in OZ-ONE reflect exercise protocols with both moderate (medium breathing) and heavy (fast breathing) ventilation rates. The count of incidence-days is computed for individuals who meet the breathing rate criteria specified in the underlying clinical study. Therefore, individuals who meet different breathing rate criteria should be considered members of different populations. As such, individuals should not be assigned to multiple breathing sub-categories for the same exposure period. Based on the above rationale, this analysis assumes that incidence-day results for populations with different breathing rates are mutually exclusive and therefore, additive.

For all clinical health endpoint categories except two (respiratory symptoms), a range of results is estimated using the following procedure: The lower bound estimate within each breathing sub-category will be summed to provide a total lower bound estimate. A similar procedure will be followed to provide an upper bound estimate for each health endpoint category. The best estimate will be defined as the sum of the mean of each breathing sub-category result. This approach makes use of all information provided by the evaluation of each model and provides a sense of the variability in the estimate of effects.

For the two remaining health endpoint categories, lower respiratory symptoms and moderate/severe lower respiratory symptoms, only one model is available for each category. Therefore, the count of incidence days from these models are presented as the best estimate for these health endpoint categories.

The following procedure will be used to aggregate the results of the epidemiological models:

Mortality: Four models were identified that predict changes in mortality rates due to changes in ozone. Although this analysis presents the results of each of the models, only the results from two of the models will be included in the aggregation procedure. As will be discussed later, this health endpoint category comprises the majority of the monetized benefits under the epidemiological approach. Given this distribution, the results of this category were examined in greater detail compared to the other categories. Closer examination of the results revealed that the estimated ozone coefficients in two of the models (the two Dockery et al. models) were estimated with a relatively low level of precision (high standard errors) and were not statistically significant from zero. Of the two remaining models, one model (Moolgavkar et al.) was statistically significant from zero while one model (Kinney et al.) provided a result of zero incidences with adequate precision. Given this information, the lower bound of the mortality category is set equal to the results of the Kinney model while the upper bound of the range is set equal to the results of the Moolgavkar model. A best estimate is not calculated for this category due to the high degree of uncertainty associated with these estimates.

Hospital Admissions: There are four categories of hospital admissions that are included in this analysis: (1) All Respiratory Illnesses; (2) Daily Respiratory Admissions; (3) Pneumonia; and (4) Chronic Obstructive Pulmonary Disease (COPD). The aggregation of these hospital admissions endpoints is more complex than that described for the mortality models because the All Respiratory Illnesses category encompasses all other hospital admissions endpoints.

For aggregation within each hospital admissions category, the following procedure is used: where there is more than one epidemiological model for any one of the categories, the model providing the lowest number incidences reduced is used as the lower bound estimate of a range while the model providing the greatest number of incidences reduced is used as the upper bound estimate of the range. The mean of the results of all models within each category will serve as the best estimate for that category.

For aggregation across the hospital admissions categories, simply summing the results of the four hospital admissions categories would result in double-counting because the first category, all respiratory illnesses, encompasses all other hospital admissions endpoints. Given that the remaining three hospital admissions endpoints are subsets of the all respiratory illnesses category, inclusion of the results from all four categories would be incorrect.

Based on the information described above, the following procedure is used for aggregating across the hospital admissions categories: Separate classifications for each category will be retained in order to preserve all information provided by the models. Estimated reductions in hospital admissions for pneumonia and COPD are reported separately using the aggregation scheme within each category as previously described. The all respiratory illnesses category encompasses all other hospital admissions endpoints, leading this category to produce a greater number of incidences than the other hospital admissions categories. In addition, this category covers the same population demographics as the hospital admissions for pneumonia and COPD. Based on the above evidence, it is possible to use results reported for the all respiratory illnesses category after subtracting the sum of the results reported for the pneumonia and COPD categories. The number of incidences remaining after the above calculation now represents hospital admissions for all respiratory illnesses except for pneumonia and COPD. As will be seen later, a willingness-to-pay value is not available for the daily respiratory admissions category. However, the procedure described above for the treatment of the other three hospital admissions categories should also capture the number of incidences that would have been estimated in the daily respiratory admissions category. Therefore, incidences estimated under the daily respiratory admissions category will be left out of the final aggregation scheme. This procedure allows all incidences reported for the hospital admissions categories to be monetized without double-counting the results.

Restricted Activity Days: Two models describe the association between ambient ozone and measures of restricted activity. The differences in these models make it difficult to implement a consistent aggregation approach within this group. The problem in ordering these two measures is definitional: it is not clear how either of these two health endpoints is defined. Another issue with these endpoints related to aggregations is how these models overlap with other models included in this benefits analysis. It is likely that calculated changes in RRADs and MRADs due to changes in ozone will involve some change in a respiratory related symptom. In this case, a separate accounting of restricted activity days will double count any symptom impacts that are also separately measured. Since this analysis includes an epidemiological model that addresses respiratory symptoms (Presence of Any of 19 Acute Respiratory Symptoms), the MRAD and the RRAD models are excluded from the aggregation scheme.

Other Health Endpoints: The remaining four health endpoints (the presence of any of 19 acute respiratory symptoms, self-reported asthma attacks, sinusitis and hay fever, and worker productivity) have only one epidemiological model that provides estimates for each effect. Therefore, there is no issue of aggregation within each group.

For all other epidemiological health endpoints, the results of each category are included in the monetization scheme if a willingness to pay estimate is available for that category. This approach to monetization should eliminate the probability of double-counting. For example, mortality and hospital admissions are distinct events. Even though a single individual may experience both effects, aggregation across these categories should not result in double-counting as long as the willingness-to-pay values properly reflect the individual's perception of each event separately. Based on our knowledge of the WTP values, many studies are careful to define the precise "good" that is to be valued. Although there is no guarantee that individual respondents did not impose their own set of criteria as to what they should be valuing, we are unaware of specific studies that have tested for the existence of an effect aggregation bias as part of the research. For example, we assume that the WTP value for avoiding any of the 19 acute symptoms is a distinct event that respondents differentiate from the WTP value that a respondent would report for avoiding an asthma attack (asthma is a chronic condition).

Worker Productivity: The worker productivity category (lower efficiency and reduced wages) does not have an aggregation issue because results produced by this model are expressed in terms of dollars (compared to incidences for all other models). Therefore, the results of this model do not need any conversion scheme. Although this benefit category does not directly measure health benefits expected to result from reduced ozone exposure, the end product measured by this model, reduced productivity, is directly related to the health of outdoor workers.

IX(B)(4)(e) NATIONAL RESULTS

All health effects models are evaluated by OZ-ONE using baseline 2007 air quality and post-rollback air quality. The results produced by OZ-ONE represent the reduction in the number of incidences (epidemiological models) or incidence-days (clinical models) given an ozone NAAQS alternative. Tables E-3 to E-6 in Appendix E present the total estimated reductions in incidences or incidence-days associated with the current ozone NAAQS. These estimates were calculated for both the regional control and local control strategies baselines. In addition, these estimates were calculated for the full attainment and partial attainment scenarios. Table E-5 shows that between five to eight million incidence-days of coughing would be reduced for outdoor workers and outdoor children under the assumption of full attainment of the current ozone NAAQS, given the regional control strategies baseline. In addition, Table E-5 shows that between 350 to 950 cases of hospital admissions would be reduced for people aged 65 years and older, using the same baseline assumptions.

This analysis, like the Staff Paper, uses epidemiological studies to estimate reductions in hospital admissions. However, the hospital admissions studies included in the section 812(a) draft report (and included in this RIA) are not identical to the hospital admissions studies used in the Staff Paper. A comparison of the hospital admissions results presented in the Staff Paper and this RIA shows that the studies used in the Staff Paper produce significantly higher benefits. Since the Staff Paper has been through extensive scientific review, the hospital admissions studies used in the Staff Paper may be incorporated into future revisions of this analysis.

Benefit estimates presented for the alternative ozone NAAQS are presented as incremental estimates to the current ozone NAAQS. These estimates are presented in Tables E-7 to E-18 in Appendix E. For example, Table E-7 presents the aggregated clinical results for the .08 ppm, 8-hour, 5 exceedance alternative under a regional control strategies baseline. Using the full attainment scenario, this analysis shows outdoor workers and outdoor children can avoid an additional 1.5 million to 2.9 million incidence-days of coughs, not counting all the coughs that were reduced for having first attained the current ozone NAAQS. Using the same regional control strategies baseline and full attainment scenario, Table E-8 provides incidence-day reduction estimates for the .08 ppm, 8-hour, 4 exceedance alternative. This table shows that incremental to the five to eight million reduction in incidence-days of coughs for having attained the current ozone NAAQS, full attainment of the 4 exceedance alternative would yield an additional 1.7 million to 3.4 million incidence-days of coughs. Clinical results for full attainment of the .08 ppm, 1 exceedance alternative are presented in Table E-9. Incremental to the current ozone NAAQS and using the same baseline assumptions as above, we should expect an additional reduction of 2.7 million to 6 million incidence-days of coughs for outdoor workers and outdoor children.

IX(B)(5) MONETIZED HEALTH EFFECT BENEFITS

The goal of this phase of the health benefits analysis is to aggregate across the disparate health endpoint categories. Although dollar estimates have been presented for each of the health endpoints presented in the quantified health benefits section of this analysis, it is important to prevent the possibility of double counting or under counting the health effects.

The quantified health effect benefits presented in the previous section represent counts of changes in specific health measures. Therefore, for each distinct health endpoint, there is a different unit of measure. This difference prevents an aggregation of impacts across models. One way to overcome this problem is to convert each physical measure of health impact into a single metric. When possible, the common metric used for all models presented in this economic benefit analysis is the willingness to pay (in dollar terms) associated with the improvement in health predicted by each model. Once all impact measures are converted to dollar measures, aggregation can be performed. This section presents the methodology and results of the model aggregation.

IX(B)(5)(a) ECONOMIC VALUATION

The social benefit associated with a change in the environment is the sum of each individual's willingness to pay for (or to avoid) the change. Historically, economists have used three techniques for valuing the social benefits resulting from reduced morbidity due to an environmental change.

A traditional valuation strategy has been the "cost of illness" (COI) approach. This approach assumes that the value of health improvements is the sum of the direct and indirect costs of illness: the health expenditures made and the loss of labor productivity. The advantage of the cost of illness approach is that economists can rely on observed human behavior. In addition, the data are not difficult to collect. This method is commonly accepted by many researchers in the health care industry because it provides estimates for the value of a wide range of health effects. However, the COI approach does not provide a conceptually correct measure of willingness to pay (WTP) because it does not account for many factors associated with experiencing or avoiding an adverse health symptom (e.g., the value of discomfort an individual feels when experiencing an adverse health symptom). A second problem with this approach is that many health symptoms may have several causes. The COI approach is only able to measure the expenditure an individual makes to treat or avoid a health symptom. This method is not able to identify the cost of illness caused by a particular pollutant. A third problem with this approach is that it unevenly treats an individual's and society's willingness to pay for the treatment or avoidance of a health symptom or risk.

The second approach is the averting behavior method. This method infers willingness to pay to reduce ambient pollution levels from expenditures to avoid exposure to air pollution (for example, the operation of air filters) or to mitigate its effects (for example, taking an antihistamine to avoid an allergic reaction). One advantage of the averting behavior approach is that it also is based on observed economic behavior. Disadvantages of this approach include: (1)It requires a considerable amount of data that is difficult to obtain; (2)One must be able to assume that the averting activity was undertaken to the point the marginal cost of the averting behavior is equal to the value of the reduced illness/risk, thereby understating the benefits if the averting activity is a zero-sum activity; (3)The averting activity may produce joint products; and (4)the individual enjoys not only the savings in expenditures but also gains in expected utility.

The third approach involves conducting a survey and directly asking people what they would be willing to pay for a good, hypothetically assuming (contingent upon) that a market for the good exists. This method, referred to as contingent valuation (CV), has been applied to a variety of non-market goods, including adverse health symptoms. CV is based on sophisticated survey techniques that may be able to yield valid and reliable WTP values. CV surveys also may address the issues of existence and bequest values because survey responses may include the moral satisfaction of contributing to public goods and charity. Although CV has been widely accepted in recent years, its application is controversial. Potential biases in willingness to pay estimates include hypothetical bias, strategic bias, starting point bias, vehicle bias, and information bias. (Freeman, 1993).

IX(B)(5)(b) VALUATION ESTIMATES

Valuation estimates from willingness-to-pay studies are used as the basis for valuing changes in the number of incidence-days of each health endpoint. With the exception of the three hospital admissions categories, all values are obtained from Appendix I of the Section 812(a) draft report. The values presented in Table XI-2 of that report should be thought of as unit values for the changes in impacts generated from the OZ-ONE computer model. For each health endpoint category, the product of the willingness-to-pay value, the per capita impacts, and the applicable population will provide an estimate of the benefits of the ozone change for that impact category.

The section 812(a) draft report includes dollar estimates for only two clinical health endpoints evaluated in this health benefits analysis: Coughs and Pain Upon Deep Inhalation. These values are presented in Table IX-2. Additionally, Table IX-2 presents per unit willingness to pay values available for epidemiological health endpoints included in this analysis. As can be seen in this table, recommended values are available for all epidemiological health endpoints but two: Sinusitis and Hay Fever and Development of Definite Asthma. Therefore, it is not be possible to assign a monetary value to these two endpoints. All unit WTP values used in this RIA are consistent with the unit values used in the section 812(a) draft report. In general, these unit values are also consistent with the PM NAAQS RIA, with the exception of the WTP value used for the Presence of Any of 19 Symptoms endpoint. The PM NAAQS RIA used a different methodology to derive a WTP value for this endpoint, which resulted in a lower unit WTP value ($18.31). The Agency will adopt a single methodology for valuing this endpoint for the RIAs for promulgation of these NAAQS.

TABLE IX- 2
WILLINGNESS-TO-PAY ESTIMATES TO AVOID MORBIDITY AND MORTALITY RISKS (1990 $)

Health Endpoint	WTP Value per Incident		
	Low Estimate	Best Estimate	High Estimate
Cough	$1.26	$7.00	$13.84
Pain Upon Deep Inhalation	$1.26	$4.41	$28.04
Mortality	N/E[1]	$4.8 million	N/E
Hospital Admissions: All Respiratory Illnesses	N/E	$11,972	N/E
Hospital Admissions: Pneumonia	N/E	$15,110	N/E
Hospital Admissions: COPD	N/E	$15,502	N/E
Presence of Any of 19 Acute Respiratory Symptoms	$3.72	$29.33	54.94
Self-Reported Asthma Attacks	$11.81	$32.48	$53.80

The reader should note that the value of the mortality endpoint is at least several orders of magnitude larger than any of the other values. The relative magnitude of this value suggests that the majority of the high end of the total monetized benefits will be driven by the mortality estimates. Recall from Table E-12 (in Appendix E) that the clinical approach does not include the mortality endpoint. Also, recall from the aggregation discussion that the low estimate for the mortality category is always equal to zero (results of the Kinney et al. model) while a "best" estimate is not calculated. Therefore, the only time the $4.8 million value (as reported in Table IX-2) is used in this analysis is when incidences of mortality are reported for the high estimate Also note that this analysis uses economic values for the three hospital admissions endpoints that are different from the values reported for the same categories in the section 812(a) draft report. The section 812(a) analysis uses the COI approach to derive an economic value for these health categories. However, since COI estimates do not measure values associated with pain and suffering (as well as other reductions in well-being) resulting from illness, they significantly understate the true WTP to avoid illness. For this reason, an adjustment factor is employed to scale the hospital admissions COI estimate upward to estimate WTP. Following the strategy employed by Chestnut, the hospital admissions COI estimate as reported in the section 812(a) draft report is multiplied by a factor of 2. This factor is based on results from three studies providing evidence on COI/WTP ratios for the same study population addressing the same change in the same health effect. While this adjustment approach is based on limited evidence, the resulting hospital admissions valuation estimate is not clearly biased.

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[1] N/E = not estimated

To summarize, this analysis monetizes the following health endpoint categories: Coughs, Pain on Deep Inhalation, Mortality, Hospital Admissions for All Respiratory Illnesses, Hospital Admissions of Pneumonia, Hospital Admissions of COPD, the Presence of Any of 19 Acute Respiratory Symptoms, and Self-Reported Asthma Attacks.

IX(B)(5)(c) NATIONAL MONETIZED BENEFITS

The monetized value of the reduction in the number of adverse health symptoms is calculated as the product of the expected reduction in the number of incidences of each symptom and the monetized value of each health symptom. The results of this computation are presented in Tables E-19 to E-29 of Appendix E. Recall that a best estimate is not provided for the mortality category due to the high degree of uncertainty associated with these estimates.

Note that results are presented separately for the clinical and epidemiological models. Results from the two approaches should be viewed as alternative methods for valuing health benefits rather than as approaches that can be aggregated. For example, the clinical approach evaluates health endpoint categories such as respiratory symptoms, coughs, and pain upon deep inhalation. These categories are similar to some epidemiological health endpoint categories included in this analysis: hospital admissions for a variety of respiratory symptoms, presence of any of 19 acute respiratory symptoms, and self-reported asthma attacks. Since an overlap is likely to occur when using the two approaches, it would be misleading and incorrect to aggregate the results from the two approaches. Therefore, the results of the clinical and epidemiological are reported separately.

However, it is possible to use the results from the two approaches to develop a range of estimates for the monetized benefits. Each approach provides a low, best, and high monetized health benefit estimate on a national basis. Since the two approaches are alternative methods for valuing health benefits, the following procedure is used to develop a range of the national monetized health benefits: The low end of the range is set equal to the approach yielding the lowest total estimate. The high end of the range is set equal to the high end of the epidemiological approach because the epidemiological models yield the greatest monetized benefit values due to the inclusion of the mortality category.

The results of this procedure are presented in Table IX-3. From the regional control strategies baseline, the monetized health benefits of fully attaining the current ozone NAAQS are expected to range between $7 million to $2.5 billion. Although the impacts of the proposed ozone NAAQS were not directly analyzed in this RIA, the impacts of the 4 exceedance and 1 exceedance .08 ppm. 8 hour alternatives can be used to bound the level of benefits we should expect from the proposed ozone NAAQS. Incremental from the results of the current ozone NAAQS, the annual health benefits of fully attaining the proposed ozone NAAQS are expected to range between $4 million and $2.3 billion. The wide range in these health benefit estimates is due to two factors: (1)the high estimate of the range includes the results of the mortality category, which comprises greater than 98% of the total estimate while the low estimate of the range excludes the mortality category and (2)the range of benefits presented for the proposed ozone NAAQS encompass the results of two NAAQS alternatives.

TABLE IX-3
SUMMARY OF ANNUAL MONETIZED HEALTH BENEFITS
Year = 2007; (Millions; 1990 $)
(Estimates are incremental from the current standard)

Ozone NAAQS	Regional Control Strategies Baseline		Local Control Strategies Baseline	
	Full Attainment Scenario	Partial attainment Scenario	Full Attainment Scenario	Partial attainment Scenario
Including Mortality Estimates[1]:				
.08 ppm, 8-hour, 4 ex.	$4 - $1,283	$2 - $597	$9 - $1,811	$4 - $894
.08 ppm, 8-hour, 1 ex.	$7 - $2,289	$4 - $1,223	$15 - $3,197	$8 - $1,635
Excluding Mortality Estimates[2]:				
.08 ppm, 8-hour, 4 ex.	$4 - $260	$2 - $116	$9 - $418	$4 - $206
.08 ppm, 8-hour, 1 ex.	$7 - $455	$4 - $237	$15 - $722	$8 - $370

The appropriate scenario to examine for benefit-cost comparisons is the partial attainment scenario. From the regional control strategies baseline, the monetized health benefits of the current ozone NAAQS are expected to range from $2 million and $650 million. Once again, the benefits of the 4 exceedance and 1 exceedance alternatives will be used to bound the expected health benefits for the proposed ozone NAAQS. Incremental from the results for the current standard, the annual health benefits of the proposed ozone NAAQS under the partial attainment scenario are expected to range between $2 million and $1.2 billion.

As noted earlier in this chapter, incidences of mortality are reported only for the high end of the monetized benefits. An examination of the contribution of the mortality estimates to the monetized benefits reveals that this category constitutes the majority (>98%) of the high end of the monetized benefits range reported for the epidemiological approach. However, the Agency also recognizes that a high degree of uncertainty exists in the estimation of ozone-induced mortality. Without considering mortality in the monetized benefits, the high end of the benefits range would now be driven by the results of the clinical approach. These results are also presented in Table IX-3. A comparison of the

[1]High end of range includes epidemiological results of Moolgavkar et al. study for mortality.

[2]High end of range taken from results of clinical approach results.

high estimates shows that generally, the high range would decrease by a factor of five for the regional control strategies baseline and a factor of four for the local controls strategies baseline. Although monetized benefits without inclusion of the mortality estimates are presented in this analysis, the Agency concludes that enough scientific evidence exists to merit consideration of this category in the analysis. Therefore, the Agency considers the monetized benefits that include the mortality category as being the most appropriate range for evaluating the benefits of reduced ozone exposure.

IX(C) WELFARE EFFECTS

This welfare benefits analysis estimates that incremental to the current NAAQS, full attainment of the proposed ozone NAAQS will result in monetized annual welfare benefits from crop yield in the range of $70 to $500 million. Adjusting the welfare estimates to reflect the presence of residual nonattainment, the annual monetized welfare benefits are expected to range between $10 and $230 million. These results are based on the CENTROID model for air quality inputs consistent with the health benefits determination. Although unquantifiable at this time, additional protection to other sensitive species and ecosystems beyond agricultural crops is expected to be significant.

IX(C)(1) INTRODUCTION

The effects of ozone on crops, ornamentals, tree seedlings, mature trees, and forested ecosystems have been studied extensively (USEPA Criteria Document for Ozone and Related Photochemical Oxidants, July 1996; and USEPA Staff Paper for Ozone, June 1996). Elevated ozone levels can inhibit the carbohydrate production that occurs through photosynthesis and can result in the reallocation of available carbohydrates (e.g., from roots to other parts of organism, causing growth decline at the root level; or affecting the long term storage of carbohydrates necessary for survival of deciduous trees which lose their leaves and undergo a period of dormancy each year). Reduced photosynthesis may also result in leaf damage, decreased yield, reduced plant biomass, increased susceptibility to pest and disease outbreaks (or increased need for pesticides), and ultimately economic losses.

In addition, the available information further suggests more subtle impacts of O_3 acting in synergy with other natural and man-made stressors to adversely affect individual plants, populations and whole systems. By disrupting the photosynthetic process, decreasing carbohydrate storage and growth in roots (reducing plant nutrient uptake), increasing early senescence of leaves and affecting water use efficiency in trees, O_3 exposure can disrupt or change the nutrient and water flow of an entire system. Weakened trees can become susceptible to pest and pathogen outbreaks, loss of competitive advantage, and decreased reproductive success (or seedling survivability), possibly resulting in reduced genetic variability within the species or entire ecosystem. The San Bernardino Forest is an example of O_3 acting as a fundamental stressor altering the ecosystem structure or species composition and arresting its development. It should be mentioned that some factors, such as light intensity, relative humidity, and soil water content, can alter a plant's sensitivity to ozone.

TABLE IX-4
WELFARE BENEFITS CATEGORIES

Quantified Benefits Categories	Unquantified Benefits Categories
Increased Yield for Commodity Crops Increased Yield for Fruits and Vegetables Increased Yield for Commercial Forests	Ecosystem and Vegetation Effects in Class I Areas (e.g., National Parks) Damage to Urban Ornamentals (e.g., grass, flowers, shrubs, trees) Reduced Yield in Tree Seedlings and Non-Commercial Forests Damage to Ecosystems (e.g., increased susceptibility to pests) Materials Damage Nitrogen Deposition in Sensitive Nitrogen-saturated Coastal Estuaries and Ecosystems Visibility

Among this range of biological vegetation effects of concern, there is also a range in the degree of effects quantification. Some effects are quantifiable, either economically or non-economically, while many can still only be discussed qualitatively. Exposure-response functions exist for a number of commercially significant crops and seedlings of sensitive tree species. Although exposure-response functions do not exist for mature trees, quantitative assessments of yield loss in commercial trees exist based on expert judgement. However, there is insufficient information at this time (USEPA Criteria Document for Ozone and Related Photochemical Oxidants, July 1996; and USEPA Staff Paper for Ozone, June 1996) to estimate the severity of some of the other impacts as a function of ozone ambient levels. Therefore, in the absence of scientific exposure-response relationships, a qualitative discussion of these other potential benefits is presented.

The rest of this section consists of two parts: Monetized Welfare Benefits Assessment and Non-Monetized Welfare Benefits Assessment. The following Table IX-4 presents a summary of the quantified and unquantified welfare benefits categories.

IX(C)(2) MONETIZED WELFARE BENEFITS ASSESSMENT

This section presents the results of the economic benefits associated with reductions in the yield of some important commercial crops for alternative standards. Adequate data are currently available to assess economic benefits for the commodity crops studied in the NCLAN project (discussed in section

VII-D.2 of the USEPA Staff Paper for Ozone, June 1996) and for fruits and vegetables grown in California.

Commodity Crops. The economic value associated with varying levels of yield loss for commodity crops was analyzed using a revised and updated (Mathtech, 1994) Regional Model Farm (RMF) (Kopp et al., 1985) agricultural benefits model. The RMF is an agricultural benefits model for crops that account for about 75% of all U.S. sales of agricultural crops (Mathtech, 1994). The results of the model are extrapolated to include 100% of the crops. The RMF explicitly incorporates exposure-response functions into microeconomic models of agricultural producer behavior. The model uses the theory of applied welfare economics to value changes in ambient O_3 concentrations brought about by particular policy actions such as attaining alternative ambient air quality standards.

The measure of welfare calculated by the model is the net change in consumers' and producers' surplus from baseline O_3 concentrations to the O_3 concentrations resulting from attainment of alternative standards. Using the baseline and post-control equilibriums, the model calculates the change in net consumers' and producers' surplus on a crop-by-crop basis. Dollar values are aggregated across crops for each standard. This dollar value represents a measure of the change in social welfare associated with the policy scenario. Although the model calculates benefits under three alternative welfare measures (perfect competition, price supports, and modified agricultural policy), the results presented here are based on the "perfect competition" measure to reflect recent changes in agricultural subsidies. Under the recently revised Farm Bill, most eligible farmers have enrolled in the program to phase out government crop price supports for the RMF-relevant crops: wheat, corn, sorghum, and cotton.

For the purpose of this analysis, six crops were analyzed: corn, cotton, peanuts, sorghum, soybean, and winter wheat. The model employs biological exposure-response information derived from controlled experiments conducted by the National Crop Loss Assessment Network (NCLAN) (Lee et al., 1996).

The RMF allows the user to choose between EPA's Regional Oxidant Model (ROM) or the Aerometric Information Retrieval System (AIRS) as the source of baseline data. AIRS and ROM are the basis for the CENTROID method. In addition, the most recent update (addendum to Mathtech 1994) of the RMF completed in June 1995 (Mathtech, 1995) allows for the use of concentration values generated from the national air quality Geographic Information System (GIS) projections developed by EPA's National Health and Environmental Effects Laboratory-Western Ecology Division (NHEERL-WED) (Lee et al., 1996).

Fruit and Vegetable Crops. There are currently no national-level economic models that incorporate fruits and vegetables, although such efforts are underway. A regional model, the California Agricultural Resources Model (CARM), has been developed and used by the California Air Resources Board (Howitt, 1995a, b). This model was used to analyze the benefits of reducing ambient O_3 on the sensitive crops grown in California (Abt, 1995a). Among these crops are the economically important fruits and vegetables endemic of California and other states with similar climate, such as Florida. The crops included in the CARM analysis are: (almonds, apricots, avocados, cantaloupes, broccoli, citrus, grapes, plums, tomatoes, and dry beans. In 1990, California crops accounted for almost 50% of the

U.S. fruit and vegetable production. The results of the model are extrapolated to include 100% of the crops.

The CARM is a nonlinear optimization model of California agriculture which assumes that producers maximize farm profit subject to land, water, and other agronomic constraints. The model maximizes total economic surplus and predicts producers' shifts in acreage planted to different crops due to changing market conditions or resources. The version of the CARM used for this analysis was calibrated to 1990 production and price data.

The quantification of benefits described in sections IX(C)(2)(A-B) below represent commodity crops and California fruits and vegetables. The results are calculated using SUM06 exposure-response functions, except for some fruits and vegetables for which those functions were not available. Results are shown incrementally from the current standard. Sections IX(C)(2)(A-B) differ in air quality inputs (CENTROID vs GIS) to the economic models. Economic models and exposure-response functions are the same for the various air quality scenarios. The air quality scenarios described in sections IX(C)(2)(A-B) are: (A) CENTROID Method, Regional and Local Control Strategies, Partial Attainment and Full Attainment; and (B) GIS Method, Full Attainment Results as presented in USEPA Staff Paper for Ozone (1996a).

IX(C)(2)(a) CENTROID METHOD: REGIONAL AND LOCAL CONTROL STRATEGIES PARTIAL ATTAINMENT AND FULL ATTAINMENT SCENARIOS

i. Background

The analysis presented here is modeled after the monetized welfare benefits analysis for agricultural crops presented in the USEPA Staff Paper for Ozone (1996a). The methodology was modified to use the CENTROID model for air quality inputs in order to be consistent with the cost and health benefits analyses and be able to add all monetized benefits and compare with the costs.

ii. Methodology

The health and welfare benefit analyses use the same ozone concentration data. Monitor data from the 1990 AIRS data base are extrapolated to the year 2007 using a statistical relationship estimated from modeled ozone concentrations. A 2007 baseline file is created which represents expected monitor concentrations with regional controls. These baseline concentrations are rolled back to reflect implementation of alternative primary and secondary ozone standards. It should be noted that the rounding assumptions of implementing the current standard have been preserved. For calculations involving a secondary standard different than a primary standard, the concentrations have been rolled back to attainment of the standard without rounding since there is no implementation precedent for rounding of a secondary standard. However, any monetized benefits attributed to achievement of a separate secondary standard should be considered slightly overestimated if a rounding convention is used for a secondary standard different than the primary.

A quadratic rollback equation is used to define improved concentration values. For the full attainment scenario calculations, rollback leads to full attainment of a standard. However, since attainment depends on the availability of emission control options, some nonattainment areas are not able to fully attain a given primary standard. For these areas, only partial attainment is assumed in the calculations under the partial attainment scenario and the benefits are reported accordingly. Once ozone concentrations are constrained by partial attainment for a particular standard, no further improvements in concentrations are possible for more stringent standards. In those areas where full attainment of a primary standard is possible, quadratic rollback reduces concentrations further to fully attain an alternative secondary standard. In those areas where full attainment of a primary standard is not possible, other rural areas outside of the nonattainment area are examined and quadratic rollback applied to attain an alternative secondary standard, if necessary.

For the partial attainment scenario (accounting for residual non-attainment), quadratic rollback is dependent on the definition of nonattainment areas for each primary standard. A design value monitor is identified within each nonattainment area. This is the monitor with the maximum value of ozone concentrations for a specific standard. This monitor establishes the rollback amounts at all other monitors in the nonattainment area. All monitors in the nonattainment area experience some rollback. However, the absolute improvements in concentrations are less at monitors with relatively better air quality because of the nature of quadratic rollback. If the design value monitor only partially attains a given standard, other monitors in the same nonattainment area will also be limited in the rollback realized for that standard.

All rollback calculations occur at monitors. Benefit calculations rely on imputed concentrations at county centroids. Once rollback values at monitors are computed for alternative standards, the CENTROID interpolation algorithm creates county centroid ozone distributions for each standard. Counties with centroids enclosed by one or more monitors in nonattainment areas will have ozone improvements. This is because all monitors in nonattainment areas experience rollback. However, counties with centroids enclosed by monitors in attainment with a specific primary standard will be examined for a secondary standard and rolled back to attain that secondary standard, if necessary. These monitors may or may not show improvement in concentrations with respect to a secondary standard.

The RMF uses statewide average changes in ozone concentrations to compute benefits. Baseline and "post-control" statewide values are computed as production weighted averages across the county centroid ozone distributions. These averages are combined with exposure-response functions estimated for different crops to predict yield changes at model farms. The RMF model incorporates the yield change information into an economic model which calculates changes in economic surplus for each crop and standard. Dollar values are aggregated across crops for each standard.

iii. Results

Table IX-5 shows monetized welfare benefits incremental to the current standard for commodity crops using RMF's competitive equilibrium measure and for California fruits and vegetables using CARM. These results are based on the CENTROID method, the use of SUM06 functions, extrapolation to 100 percent of the crops, and 1990 dollars. Results are shown for both the RCS and LCS scenarios under both assumptions of full attainment and partial attainment scenario. Estimates for achieving the current standard range from $190-250M under the RCS full

TABLE IX-5
Monetized Ozone Welfare Benefits Incremental to the Current Standard Based on RMF[1]
(Millions of dollars)

ALTERNATIVE STANDARD	REGIONAL CONTROL STRATEGY		LOCAL CONTROL STRATEGY	
	FULL ATTAINMENT	PARTIAL ATTAINMENT	FULL ATTAINMENT	PARTIAL ATTAINMENT
.08ppm, 8hr, 4X	$72-120[2]	$10-50[2]	$100-230[2]	$50-170[2]
.08ppm, 8hr, 1x	$195-520	$65-230	$185-610	$115-450

Table IX-6
Comparison of GIS and CENTROID Results: Monetized Ozone Welfare Benefits Incremental to the Current Standard Based on RMF[3] (in millions of dollars)

ALTERNATIVE STANDARD	GIS: FULL ATTAINMENT	CENTROID: REGIONAL CONTROL STRATEGY	CENTROID: LOCAL CONTROL STRATEGY
.08ppm, 8hr, 1x	$420-1,250	$195-520	$185-610

[1]Competitive Equilibrium Measure, CARM, CENTROID, SUM06 Functions, Extrapolation to 100% of Crops, Areawide Rollback, Regional Control Strategy and Local Control Strategy

[2]Does not include results from CARM (in progress) nor results from the commercial forests analysis because they are not directly additive in this scenario

[3]Competitive Equilibrium Measure, CARM, SUM06 Functions, Extrapolation to 100% of Crops

attainment scenario to \$220-300M under the LCS full attainment scenario. A stringent secondary standard incremental to the current primary is estimated to add between \$200-300M under either scenario. Estimates for achieving the current standard range from \$110-150M under the RCS partial attainment scenario to \$140-180 under the LCS partial attainment scenario. A stringent secondary standard incremental to the current primary is estimated to add up to \$100M.

The range of results from this analysis represents impacts associated only with available NCLAN experimental data. Not all cultivars of a crop have been subjected to exposure-response experiments. Furthermore, the mix of cultivars actually grown in 1990 is not represented by any single cultivar examined during the NCLAN study. The RMF benefits results associated with either the "minimum" or "maximum" exposure-response function (endpoints of the range presented) simply represent impacts that span a range of possible results that could be obtained with available experimental information. To project monetized benefits nationwide, estimates are extrapolated to 100% of the crops because the analyses account for only 75% of the commodity crops and 50% of the fruit and vegetables. A rough approximation of a national estimate is calculated by proportionally scaling the monetized estimates to the entire market. It is recognized, however, that factors such as the sensitivity of other cultivars to O_3, regional air quality, and regional economics introduce considerable uncertainty to any such approach to develop national estimates.

The results from this analysis measure the national economic effects of changes in ambient O_3 levels on the production of a subset of important commodity crops and California fruits and vegetables. The results indicate that a reduction in O_3 from 1990 ambient levels to a controlled level results in a monetary net benefit. Conversely, an increase in O_3 to an assumed ambient concentration across all regions produces a net loss. The results indicate that reductions in O_3 from an estimated 2007 baseline to controlled levels result in a monetary net benefit. Two levels of response were evaluated for each standard to reflect the minimum response and the maximum response based on results for various cultivars in each crop.

It is important to restate and summarize the uncertainties associated with the results of the monetized crop yield loss analysis. Uncertainties are introduced by: (1) the extrapolation of limited monitored air quality data to national air quality distributions; (2) the application of exposure-response functions from NCLAN open-top chamber studies extrapolated to 1990 ambient air exposure patterns and crop production; (3) the use of alternative non-NCLAN exposure-response functions for a variety of fruits and vegetables not included in the NCLAN studies; (4) the use of a quadratic rollback methodology to project the "just attain" air quality distributions without a direct link to an emissions control strategy; and (5) the use of economic models with inherent uncertainties. In addition, estimated yield losses are directionally overestimated because they are based on NCLAN-derived functions which use a background concentration of 0.025 ppm instead of a background level of 0.04 ppm (which is the midpoint of the range assumed in Section IV of the USEPA Staff Paper for Ozone, June 1996). Overestimation of yield losses results in higher benefits. Quantification of the individual or compounded effects of these uncertainties, or of the directional bias resulting from the above assumptions, is infeasible at this time. The results presented should be viewed as rough approximations.

IX(C)(2)(b) GIS-BASED METHOD: FULL ATTAINMENT SCENARIO

I. Background

A summary of the methodology and results of the monetized crop loss analysis presented in the Staff Paper is included here for comparison purpose. The main differences between the two analyses are: the GIS model was used for the Staff Paper analysis, the CENTROID model was used for the RIA analysis; and the current implementation rounding convention was not used in the Staff Paper analysis, but was used for the RIA analysis. This comparison is presented to show that these models produce similar results, notwithstanding the uncertainties that surround both.

ii. Methodology

For a more detailed description of the methodology that employs the GIS model, refer to the USEPA Staff Paper (1996a). The National Health and Environmental Effects Research Laboratory-Western Ecology Division (NHEERL-WED) in Corvallis developed a Geographic Information System-based (GIS-based) approach (Lee et al., 1996 and Herstrom et al., 1995) to model air quality that has characteristics of both interpolation and modeling. Although this integrated GIS-based approach is not as complex as a true computer model, it has the advantage of using data that is readily available across the entire country, it is very inexpensive to run, and it allows one to quickly produce exposure estimates of any exposure index for multiple months or years. For RMF applications, the most important advantage of the approach is its ability to produce a dense grid of O_3 exposure values across the U.S. The major limitation associated with the use of the GIS approach is the lack of monitored air quality data in rural areas. The baseline for the welfare benefits calculated in this analysis was the 1990 air quality. The year 1990 is considered a representative year and predicted air quality is rolled-back to attainment of the standards being analyzed. The 1990 air quality baseline was chosen for consistency reasons: it is the baseline used for modeling, implementation, and other analyses related to the O_3 standard review.

As with any spatial interpolation technique that must rely on sparse data representative of urban or near-urban areas, the uncertainty of the GIS-based O_3 estimation technique is great and non-quantifiable. However, the ability of the GIS-based technique to capture trends and variations of O_3 exposure between monitored sites is theoretically improved over other available methods because it attempts to account for ozone formation and decay, wind direction, cloud formation, temperature, and elevation.

A quadratic roll-back procedure (Horst, 1995a) was used to generate post-control conditions. This procedure produces a distribution of O_3 concentrations that reflect projected air quality when an alternative standard is "just attained". The "just-attained" air quality distribution is not directly linked to an emissions control strategy **and does not use a rounding convention.**

iii. Results

As evidenced by the results presented in table IX-6, it is estimated that, based on the GIS model, positive incremental benefits result from attaining a primary standard different from the current standard. For a 0.08ppm, 8hr, 1exceedance standard, the benefits incremental to the current standard are estimated in the range of $420-$1,250. Based on the GIS model, estimates for achieving the current standard range from $250-420M, with incremental benefits from a stringent secondary standard estimated to add between $450-830M.

Table IX-6 shows a comparison of the CENTROID-based RCS and LCS full attainment scenarios to the GIS-based results. The main differences between the two analyses are: the GIS model was used for Staff Paper analysis, while the CENTROID model was used for the RIA analysis; and the current implementation rounding convention was not used for the Staff Paper but was used for the RIA. This comparison is presented to show that these models produce similar results, notwithstanding the uncertainties that surround both.

To put the above analyses in perspective, benefits from economic studies reported in the 1996 Criteria Document (1996b) range from $1.3 billion to $2.5 billion. Two of the cited studies were national in scope and judged adequate in terms of data inputs. Kopp et al. (1985), using the RMF including corn, soybeans, wheat, cotton, and peanuts, reported $1.3 billion (1980 dollars) in benefits from the reduction of ambient O_3 from 53 to 40 ppb. Adams et al. (1986) included corn, soybeans, cotton, wheat, sorghum, and barley, and reported $1.7 billion (1980 dollars) in benefits from a 25% reduction in ambient O_3 from 1980 levels. These results are not directly comparable to the results of either the GIS-based or the CENTROID-based analyses because they are based on higher baseline air quality (1980 versus 1990 versus 2007, respectively), and they are based on different post-control average air quality levels that cannot be related to the alternative standards used in this analysis.

An examination of the monetized benefits indicates that most of the welfare benefits accrue from the attainment of the 8-hr primary standard alternatives with a small incremental improvement obtained by the addition of a seasonal secondary standard. The projected national approximations for commodity crops, fruits and vegetables, urban ornamentals, and commercial forests in the east suggest benefits in the order of 100 to 600 million dollars for a new 8-hour, 0.08 ppm primary standard alone or in combination with a seasonal secondary standard. Based on scientific information, monetized benefits alone understate the public welfare benefits obtained from the adoption of an 8-hour primary standard alone or in combination with a new seasonal secondary standard.

IX(C)(3) NON-MONETIZED WELFARE BENEFITS

Additional consideration should be given to potential benefits from categories which have not been monetarily valued, either because no direct measures of their value exist or because the indirect measurement techniques, such as contingent valuation studies, may be considered controversial. These unmonetized categories include: ecosystem and vegetation effects in Class I areas; damage to urban ornamentals; reduced yield in tree seedlings and non-commercial forests; damage to ecosystems;

materials damage; nitrogen deposition in sensitive nitrogen-saturated coastal estuaries and ecosystem; and visibility.

Based on the studies of agricultural crops and the benefits estimated here, a significant degree of vegetation protection is estimated to be afforded by an alternative primary standard more stringent than the current standard. Although unquantifiable at this time, additional protection to other sensitive species or individuals within a species could be potentially significant at regional or local levels.

Following is a brief discussion aimed at highlighting what is "at stake" for two categories of ozone-sensitive vegetation groups for which complete monetization has not been calculated. These two categories are urban ornamentals and commercial forests.

Ornamentals and Commercial Forests. Urban ornamentals and commercial forests are additional vegetation categories that represent large economic sectors which are likely to experience some degree of effects associated with exposure to ambient O_3 levels. However, in the absence of adequate exposure-response functions and economic damage functions for the potential range of effects relevant to these types of vegetation, no direct quantitative economic benefits analysis has been conducted. However, significant economic benefits could potentially result upon attaining the alternative standards analyzed above for commercial crops and fruits and vegetables.

Ornamentals used in the urban and suburban landscape include shrubs, trees, grass, and flowers. The types of economic losses that could potentially result from effects that have been associated with O_3 exposure include: 1) reduction in aesthetic services over the realized lifetime of a plant, 2) the loss of aesthetic services resulting from the premature death (or early replacement) of an injured plant, 3) the cost associated with removing the injured plant and replacing it with a new plant, 4) increased soil erosion, 5) increased energy costs from loss of shade in the urban environment, 6) reduced seedling survivability, and 7) any additional costs incurred over the lifetime of the injured plant to mitigate the effects of O_3-induced injury. It is estimated that more than $20 billion (1990 dollars) are spent annually on landscaping using ornamentals (Abt, 1995), both by private property owners/tenants and by governmental units responsible for public areas, making this a potentially important welfare effects category However, information and valuation methods are not available to allow for plausible estimates of the percentage of these expenditures that may be related to impacts associated with O_3 exposure.

Recognizing this limitation, but based on data assessing retail expenditures on environmental horticulture at $23B in 1991 and because of the large uncertainties in the realm of ecological benefits assessments, we venture to theorize that if only half of a percent of public expenditures on ornamentals could be traced to ozone-induced damage that would be avoided with a revised ozone standard, then these benefits would amount to $115M.

Any attempt to estimate economic benefits for commercial forests associated with attaining alternative O_3 standards is constrained by a lack of exposure-response functions for the commercially important mature trees. Although exposure-response functions have been developed for seedlings for a number of important tree species, these seedling functions cannot be extrapolated to mature trees based on current knowledge. Recognizing this limitation, a study by Pye et al. (1988a,b) used a method involving expert judgments about the effect of O_3 levels on percent growth change to develop estimates of O_3-related economic losses for forest products.

An analysis by Mathtech (1995) of forestry sector benefits describes quantitatively the effect of ozone on tree growth and the demand and supply characteristics of the timber market. This analysis uses modeled baseline ozone concentrations and a rollback strategy to represent ozone improvement scenarios. The ozone data used in this analysis coincide with the data used in the agricultural sector benefits analysis presented in the USEPA Staff Paper (1996a). The estimates do not include possible non-market benefits such as aesthetic effects.

The analysis is limited to the eastern United States without attempts to extrapolate to the West due to lack of data on the economic relationships in the national timber market, and timber acreage and mix of trees in the West. According to the 1993 Statistical Abstract, more than half of wood production takes place in the western United States.

Until additional effects information becomes available in the form of exposure response functions for mature trees or for allowing extrapolation of seedling exposure-response functions to mature trees, the uncertainties associated with estimating monetized benefits for mature commercial trees will remain. However, based on results from the expert judgement surveys that suggest that the impact of current ambient ozone on annual growth for commercial trees in the Northeast and Southeast is about 1 percent yield reduction per year, and adopting a series of assumptions to establish consistency across several sources of data (Mathtech 1995b), an analysis of commercial forest benefits shows benefits incremental to the current standard based on a primary standard of 0.08ppm 8hr, 1x to be in the range of $15-120M. This range cannot be simply extrapolated to other standard scenarios to be included in the total monetized benefits, but it is presented here to highlight what is at stake from ozone effects.

IX(D) SUMMARY OF HEALTH AND WELFARE BENEFITS

The purpose of this section is to summarize the health and welfare benefits discussions presented earlier in this benefits chapter. Annual monetized benefits have been presented separately for health and welfare effects. It is now possible to sum these health and welfare benefits to provide a more complete depiction of the total benefits expected to result from attainment of the proposed ozone NAAQS. These results are presented in table IX-7. Using the 4 exceedance and 1 exceedance, .08 ppm, 8 hour alternatives to bound the results, full attainment of the proposed ozone NAAQS (incremental from attainment of the current standard and calculated from the regional control strategies baseline) is expected to yield total annual monetized benefits in the range of $76 million to $2.8 billion. From these baselines, but adjusting for the presence of residual nonattainment, total annual monetized benefits for the proposed ozone NAAQS are expected to range between $12 million and $1.5 billion.

Population estimates for the 2007 analytical year are also relevant for this benefits analysis. From the Regional Control Strategy baseline, the population estimated to be in nonattainment areas is approximately 60 million people for the current standard. For the standards that bound the proposed NAAQS, and incremental from the current standard, the population estimated to reside in nonattainment areas is expected to range between 39 million and 89 million people.

TABLE IX-7
Summary of Annual Monetized Health and Welfare Benefits
Year = 2007
(Millions; 1990 $)
(Estimates are incremental from the current standard)

Ozone NAAQS	Regional Control Strategies Baseline		Local Control Strategies Baseline	
	Full Attainment Scenario	Partial Attainment Scenario	Full Attainment Scenario	Partial Attainment Scenario
.08 ppm, 8-hour, 4 ex.	$76 - $1,403	$12 - $647	$109 - $2,041	$54 - $1,064
.08 ppm, 8-hour, 1 ex.	$202 - $2,809	$69 - $1,453	$200 - $3,807	$123 - $2,085

Caveats:
*Many categories of unquantified/unmonetized benefits
*Health benefits not calculated outside identified nonattainment areas even though emission reductions withing nonattainment areas are expected to reduce ozone concentrations outside of nonattainment areas

For the Local Control Strategy baseline, population estimates associated with nonattainment areas for the current standard are approximately 93 million people. Incremental from the current standard and for the standards that bound the proposed standard, population estimates range between 44 million to 86 million people.

The additional costs and health benefits of a separate secondary standard have not been estimated. However, a number of inferences can be made from the results of the welfare benefits analysis under the full attainment scenarios. For the proposed standard, monetized benefits from commodity crops of the most stringent secondary standard incremental to the primary standard are close to zero. This indicates that the proposed primary standard is binding for those areas where commodity crops are grown (which includes California). For these areas, there would be no incremental improvements and, therefore, no additional costs or health benefits. For areas where we do not know if the proposed primary standard is binding (areas where commodity crops are not grown), the air quality database created to perform the commodity crops analysis could be used to estimate any additional health benefits. These benefits are expected to be small because the benefits curves flatten as the air quality improves marginally. However, cost estimates are not available for these areas because of incomplete emissions inventory data at this time. The Agency will attempt to address these costs in the RIA for promulgation of the proposed NAAQS.

In considering these monetized benefit estimates, the reader should be aware that many limitations for conducting these benefit analyses have been mentioned throughout this RIA. One significant limitation of both the health and welfare benefit analyses is the inability to quantify many ozone-induced effects. Table IX-8 lists the categories of benefits that this analysis was able to quantify and those discussed only in a qualitative manner. In general, if it were possible to include the unquantified benefit categories in the total monetized benefits, the benefit estimates presented in this RIA would increase.

As discussed in the ozone Staff Paper, human exposure to ozone is known to cause health effects such as: airway responsiveness, increased susceptibility to respiratory infection, acute inflammation and respiratory cell damage, premature aging of the lungs and chronic respiratory damage. An improvement in ambient ozone air quality (due to implementation of the proposed ozone NAAQS) is expected to reduce the number of incidences within each effect category that the U.S. population would experience. Although these health effects are known to be ozone-induced, scientific information in the form of concentration-response data was not available for quantifying the benefits associated with reducing these effects. The inability to quantify these effects leads to an underestimation of the monetized benefits presented in this analysis.

Another short-coming of the health benefit estimates is the inability to monetize many health effects even though scientific data was available to estimate the reductions in incidences. Aggregation issues and/or the lack of economic valuation estimates prevented the monetization of these reductions in incidences. These health effects include: change in lung function (DFEV), lower respiratory symptoms, and restricted activity days. Although some degree of overlap exists between these symptoms and other health end-points that were monetized in this analysis (e.g., change in lung function may lead to an asthma attack), it is clear that the monetized health benefits presented in this RIA underestimate the total benefits attributable to the proposed ozone NAAQS by omitting these categories from the total monetized health benefits.

TABLE IX-8
Summary of Unquantified and Quantified Benefit Categories

Unquantified Benefit Categories	**Quantified Benefit Categories (in numbers of incidences and/or dollars)**
Health Benefit Categories (from a reduction in ozone and related pollutants)	
Airway responsiveness Increased susceptibility to respiratory infection Acute inflammation and respiratory cell damage Premature aging of lungs/Chronic respiratory damage Reduced cancer and adverse attacks from toxic ozone precursors and associated oxidant products Reduced mortality/morbidity from lower fine particle levels	Coughs Pain upon deep inhalation Mortality Hospital admissions for all respiratory illnesses Hospital admissions for pneumonia Hospital admissions for chronic obstructive pulmonary disease (COPD) Presence of any of 19 acute respiratory symptoms/restricted activity days Self-reported asthma attacks Worker productivity Change in lung function[1] Lower respiratory symptoms

[1]Scientific term is change in forced expiratory volume (FEV)

Welfare Benefit Categories	
Ecosystem and vegetation effects in Class I areas (e.g. National Parks) Damage to urban ornamentals (e.g., grass, flowers, shrubs, trees) Reduced yields of tree seedlings and non-commercial forests Damage to ecosystems Materials damage Nitrogen deposition in sensitive nitrogen saturated coastal estuaries and ecosystems Visibility	Increased yields for: Commodity crops Fruits and vegetables Commercial forests

A potential significant health benefit category associated with the proposed NAAQS is that toxic ozone precursors and associated oxidant products are also expected to be reduced. Exposure to toxic air pollutants can cause cancer and other adverse effects in humans. The proposed NAAQS would require a reduction in ozone precursor emissions, some of which are likely to include toxic air pollutants. Not being able to quantify these effects leads to an underestimation of the monetized benefits.

As has been previously presented in this RIA, control strategies to improve ambient ozone concentrations focus on reducing emissions of ozone precursors -- VOC and NOx. The reduction of NOx emission reductions is expected to affect not only ambient ozone concentrations but also ambient PM concentrations since NOx is also a precursor for PM formation. The lack of a comprehensive national modeling prevents a generalizable and quantifiable relationship to be established between NOx emission reductions and the resulting effect on PM in this analysis. However, it is expected that if NOx and VOC emissions are reduced, health improvements related to reduced PM exposure would occur. The effect of quantifying this category would be to increase the monetized benefit estimates presented in this RIA.

Also related to NOx emission reductions is the effect these reductions are expected to have on nitrogen deposition in certain estuaries where nitrogen is a nutrient contributing to eutrophication. Specifically, the effect of nitrogen deposition on the Chesapeake Bay has been studied. This examination was possible partly because a relationship was established between NOx emissions and nitrogen deposition. The effect of adding this category to the monetized benefits would be to increase the estimates.

Another category, reductions of ozone damage to commercial forests, has been partially monetized in this analysis. Results from expert judgement surveys suggest that the impact of current ozone on annual growth for commercial trees in the Northeast and Southeast is about one percent yield reduction per year. The ozone-relevant species included in the surveys are: high elevation spruce, southern pines, southern hardwoods, northern hardwoods, and low elevation spruce. Based on this judgement and a series of assumptions adopted to establish consistency across several sources of data, an analysis of commercial forest benefits (Mathtech 1995b) shows incremental benefits under the most stringent 8 hour, .08 ppm, primary standard alternative in the range of $15 million to $120 million. This range cannot be simply extrapolated to other standard scenarios to be included in the total monetized benefits, but it is presented here to highlight what is at stake from ozone effects. Although benefit estimates are not available for the other alternative NAAQS analyzed in this RIA, it is clear that adding this category of benefits to the monetized benefits for each ozone alternative would increase the estimates.

Another category of potential benefits is related to the effect of ozone on urban ornamentals (e.g., plants used in urban landscaping). Urban ornamental plants represent an important area of welfare loss associated with ozone damage. Urban (and suburban) ornamentals include: grass, flowers, shrubs, and trees. Quantifying economic losses from ozone-induced damage to urban ornamentals is restricted by the lack of exposure response functions for a significant number of sensitive species, wide variation in plant sensitivity across and within species, and difficulty in monetizing the value associated with specific injuries. A report about the economic implications of injury to urban ornamentals (Abt, 1995b) cites USDA data assessing retail expenditures on environmental horticulture at $23 billion in 1991. A survey for the National Gardening Association estimated household spending on plants, turf, associated pest control and maintenance, and landscaping at $23 billion in 1992. Although there is no analytically solid method to connect these expenditures to ozone-induced damage, but because of the large uncertainties in the realm of ecological benefits assessments, we venture to theorize that if only half of a percent of public expenditures on ornamentals could be traced to ozone-induced damage that would be avoided with a revised ozone standard, then these benefits would amount to $115 million. The addition of this category would increase the monetized benefit estimates presented in this RIA.

There are other benefit categories for which there is incomplete information to permit a quantitative assessment of benefits for this analysis. For some endpoints, gaps exist in the scientific literature or key analytical components and thus do not support an estimation of occurrences. In other cases, there is insufficient economic information to allow estimation of the economic value of adverse effects. Thus, this benefit analysis is incomplete with respect to full coverage of all potential benefits for ozone alternatives. These potentially significant, but unquantified welfare benefit categories include: existence and user values related to the protection of Class I areas (e.g., Grand Canyon National Park), tree seedlings for more than 10 sensitive species (e.g., black cherry, aspen, ponderosa pine), non-commercial forests, ecosystems, visibility, materials damage, and reduced acid deposition (nitrates) to aquatic and terrestrial ecosystems. Although scientific and economic data are not available to allow quantification of the effect of ozone in these categories, the expectation is that, if quantified, each of these categories would lead to an increase in the monetized benefits presented in this RIA. For example, the National Acid Precipitation Assessment Program (NAPAP) reports that user values for visibility changes at recreation sites in the east and west are in the range of $1-$10 per visitor per day. Similarly, estimates of the economic effects of acidic deposition damages on recreational fishing in the Adirondack region of New York ranging from $1 million to $13 million annually.

In this list of unquantified benefits, one category of disbenefits must also be mentioned. Some commentors have suggested that a reduction of ozone to meet health and welfare-based standards might serve to increase the penetration of ultraviolet light, specifically UV-B, to ground level. This effect would be a disbenefit to the extent any such increase would increase skin cancer and other effects associated with increased penetration of UV-B. EPA conducted an analysis and review of the extent to which the kinds of ozone reductions anticipated for the difference between the current 1-hour and possible 9-hour standards might produce such an effect. The review concluded "(1) the numbers resulting from these calculations are quite small and (2) the limitations of the accuracy and reliability of the input to the calculations produces numbers that cannot be defended, whether large or small." (Childs, 1994). Accordingly, no attempt to quantify this potential effect, which is expected to be small, has been made in this analysis.

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X BENEFIT-COST COMPARISON

X(A) INTRODUCTION

This chapter provides a discussion of the economic efficiency framework for evaluating alternative ozone NAAQS. The adoption and implementation of pollution control technologies to improve ozone air quality are not free. There is a reallocation of society's resources to address the ozone air pollution problem. In the course of internalizing the air pollution externality, the cost of reducing VOC and NOx emissions through this NAAQS is reflected in the production, distribution, and consumption of products affected by the rulemaking. This additional cost is in contrast to the improvement in society's well-being from a cleaner environment and concomitant reductions in adverse health and welfare effects. The purpose of this chapter is to compare the identified marginal costs and monetized marginal benefits attributable to the emission reductions and resulting ozone air quality. This comparison provides information regarding the relative efficiency of the proposed ozone NAAQS.

However, the reader should be reminded that both the Agency and the courts have defined the NAAQS standard setting process as a fundamentally health-based decision that specifically is not to be based on cost or other economic considerations. This benefit-cost comparison, therefore, is intended to generally inform the public about the potential costs and benefits that may result when the proposed revisions to the ozone NAAQS are implemented by the States.

X(B) COMPARISON OF BENEFITS TO COSTS

Table X-1 shows the national monetized benefits (with full attainment and adjustment for residual nonattainment), costs, net benefits (monetized benefits minus costs), and level of residual nonattainment (by number of nonattainment areas) for each ozone NAAQS alternative, given the regional control strategies baseline. The annual benefits presented in this table represent total monetized benefits for health and welfare effects. The total annual costs represent the costs of attaining each alternative NAAQS, not accounting for residual nonattainment. The appropriate benefit and cost estimates to compare are the monetized benefits of the partial attainment scenario compared to the annual costs. Table X-2 shows national monetized benefits, costs, net benefits, and level of residual nonattainment for the alternative NAAQS, given the local control strategies baseline.

X(C) KEY RESULTS AND CONCLUSIONS

- The inability to monetize a number of significant benefit categories may constitute sufficient reason to believe that the net benefits associated with the proposed NAAQS are positive.

- Within the uncertainties of these analyses and their underlying assumptions, costs and benefits seem to be of similar magnitude for the partial attainment of the alternatives which bound the proposed approach.

- The scope of this analysis did not allow for an in-depth examination of the interrelationship between ozone and PM. The implementation portion of this NAAQS review will also address co-control measures and the cross-pollutant effects of ozone and PM management. Due to these non-quantified interrelationships, the costs presented in this RIA may overstate the control measure costs. To this extent, the net benefits presented in this RIA will be underestimates.

- The scope of this analysis did not allow consideration of flexibility in ozone management. The Agency expects the implementation portion of this ozone NAAQS review to result in lower costs. This is another major reason why the cost estimates presented may overstate the costs of control and the net benefit estimates presented may understate actual net benefits.

X(D) GENERAL LIMITATIONS ON THE BENEFIT-COST COMPARISON

There are several general limitations specific to the comparison of benefits and costs for these ozone NAAQS alternatives. They are:

- Many benefits from ozone control could not be monetized in the benefit analysis, which in turn affect the benefit-cost comparison. Unmonetized benefit categories include: effects in lung function; chronic respiratory damage and premature aging of the lungs, sinusitis and hay fever; increased susceptibility to respiratory infection; and protection of Class I areas, forests, ornamental plants, mature trees and seedlings, and ecosystems. The effect of our inability to monetize these benefit categories leads to an underestimation of the monetized benefits presented in this RIA.

- Health benefits calculated in this analysis were estimated only within each identified nonattainment area. However, the reduction of ozone precursor emissions in nonattainment areas is expected to reduce ambient ozone concentrations outside of the nonattainment areas due to the transport of air pollution. The effect of not estimating health benefits outside of the identified nonattainment areas leads to an underestimation of the monetized benefits presented in this analysis.

- The uncertainty associated with the benefit estimates may be significantly greater than the uncertainty associated with the costs estimates. In particular, the benefit estimates vary greatly depending on the mortality risk reduction measure. This issue leads to caution in interpreting this ozone benefit-cost comparison.

- There are uncertainties in the adjustment of the benefit calculations to account for residual nonattainment (labeled as partial attainment).

- Due to uncertainties associated with the air quality model (which results in an overestimation of the emission reduction targets), an assumption was made that if an area could achieve at least 75% of its emission reduction target, it was assumed to potentially be able to attain the alternative standard. (See the cost chapter for a more complete discussion of this assumption.)

- Under the current implementation strategy, marginal nonattainment areas generally undertake non-control pollution management efforts (e.g., develop an emissions inventory and keep it updated). This analysis assumes that these efforts indirectly produce air quality improvements. To the extent that there are control costs associated with marginal nonattainment areas, this analysis may underestimate the costs which these areas will actually incur.

- Comparisons across alternative standards should be made with caution because control strategies identified do not result in full attainment of the alternatives. As the stringency of the standard increases, areas showing residual nonattainment will have a more difficult time to meet a more stringent standard and the cost of this increasing difficulty is not included in these estimates.

- The costs presented in this analysis represent the control costs of a partial attainment scenario, given the existence of residual nonattainment. Due to significant uncertainties, this analysis does not estimate full-attainment costs. However, the cost chapter provides information on average cost per ton values in conjunction with emission reduction information for the reader's consideration.

- The cost and benefit estimates presented in the results do not account for market reactions to the new alternatives. The cost and benefit estimates represent the direct costs and benefits but no the true social costs (calculated after market adjustments to price and output changes, etc.) associated with implementation of the alternatives examined. Social costs are typically somewhat smaller than direct costs, while social benefits may be greater or less than direct benefits depending on the specific market adjustments and substitutions that occur. Because the effect of market reactions was not assessed, indirect costs and benefits to consumers and producers could not be quantified. It is anticipated that some of the costs associated with control measures will be borne indirectly by consumers instead of producers.

Table X-1
Comparison of Benefits and Costs[1]
Regional Control Strategies Baseline[2]
(Billions of 1990$)
(Estimates are incremental from the current standard)

Alternative Ozone NAAQS	Annual Monetized Benefits		Annual Costs[3] of Partial Attain-ment (c)	Annual Net Benefits[4] (b-c)	Number of Nonattainment Areas	Residual Nonattainment (RNA)		
	Full Attainment (a)	Partial Attainment (b)				Number of RNA Areas	Deficit Tons Associated with RNA Areas (in thousands)	Population in RNA Areas
Current Standard[5]	$0.2 - $2.7	$0.1 - $0.8	$1.2	$(1.1) - $(0.4)	20	4	VOC =370-562 NOx=0	39 million
Incremental from the Current Standard:								
80 ppb, 8 hour, 4 AX	$0.1 - $1.4	$0 - $0.6	$0.6	$(0.4) - $0	17	8	VOC=102-155 NOx=17-25	14 million
80 ppb, 8 hour, 1 AX	$0.2 - $2.8	$0.1 - $1.5	$2.5	$(2.4) - $(1.0)	55	20	VOC=422-642 NOx=73-111	32 million

1 Numbers may not completely agree due to rounding.
2 Includes NOx cap and 49-state LEV.
2 The costs of residual nonattainment has not been estimated. However, the reader should refer to the cost chapter for a discussion of average cost per ton values that may be used to estimate the costs associated with residual nonattainment.
3 Numbers in ( ) denote negative values.
4 The current standard is assumed to be approximately equal to an 8-hr., .09 ppm, 2AX alternative.

Caveats:
Significant analytical uncertainties
Limited to existing implementation, basically add-on control measures
Many nonquantified costs and benefits
Does not consider ozone and PM integration issues

Table X-2
Comparison of Benefits and Costs[1]
Local Control Strategies Baseline[2]
(Billions of 1990$)
(Estimates are incremental from the current standard)

Alternative Ozone NAAQS	Annual Monetized Benefits		Annual Costs[3] of Partial Attain-ment (c)	Annual Net Benefits[4] (b-c)	Number of Nonattainment Areas	Residual Nonattainment (RNA)		
	Full Attainment (a)	Partial Attainment (b)				Number of RNA Areas	Deficit Tons Associated with RNA Areas (in thousands)	Population in RNA Areas
Current Standard[5]	$0.2 - $3.3	$0.1 - $1.1	$2.3	$(2.2) - $(1.2)	20	9	VOC =506-770 NOx=8-13	57 million
Incremental from the Current Standard:								
.08 ppm, 8 hour, 4 X	$0.1 - $2.0	$0.1 - $1.1	$2.2	$(2.4) - $(1.1)	41	12	VOC=188-285 NOx=36-54	28 million
.08 ppm, 8 hour, 1 X	$0.2 - $3.8	$0.1 - $2.1	$6.3	$(6.2) - $(4.2)	102	37	VOC=515-783 NOx=117-178	53 million

1 Numbers may not completely agree due to rounding.
2 This scenario represents an unlikely air quality baseline scenario for 2007. The reader should refer to the regional control scenario for a better estimate of the likely costs and benefits.
3 The costs of residual nonattainment has not been estimated. However, the reader should refer to the cost chapter for a discussion of average cost per ton values that may be used to estimate the costs associated with residual nonattainment.
4 Numbers in ( ) denote negative values.
5 The current standard is assumed to be approximately equal to an 8-hour, .09 ppm, 2AX alternative.

Caveats:
Significant analytical uncertainties
Limited to existing implementation, basically add-on control measures
Many nonquantified costs and benefits
Does not consider ozone and PM integration issues

APPENDIX A

NONATTAINMENT AREA COUNTIES AND TARGET REDUCTIONS UNDER EACH ALTERNATIVE NAAQS

TABLE A-1
MODELED NONATTAINMENT AREA COUNTIES FOR THE CURRENT STANDARD UNDER THE REGIONAL CONTROL STRATEGY

NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME
Atlantic City	Atlantic	Houston	Waller	New York	Richmond
Atlantic City	Cape May	Los Angeles	Los Angeles	New York	Rockland
Bakersfield	Kern	Los Angeles	Orange	New York	Somerset
Baton Rouge	Ascension	Los Angeles	Riverside	New York	Suffolk
Baton Rouge	East Baton Rouge	Los Angeles	San Bernardino	New York	Sussex
Baton Rouge	Livingston	Los Angeles	Ventura	New York	Union
Baton Rouge	W. Baton Rouge	New Haven	New Haven	New York	Westchester
Beaumont	Hardin	New London	New London	Phoenix	Maricopa
Beaumont	Jefferson	New London	Washington	Portland, ME	Cumberland
Beaumont	Orange	New London	Windham	Portland, ME	York
Bridgeport	Fairfield	New York	Bergen	Portland, OR	Clackamas
Cincinnati	Boone	New York	Bronx	Portland, OR	Clark
Cincinnati	Butler	New York	Essex	Portland, OR	Multnomah
Cincinnati	Campbell	New York	Hudson	Portland, OR	Washington
Cincinnati	Clermont	New York	Hunterdon	Portland, OR	Yamhill
Cincinnati	Dearborn	New York	Kings	Reno	Washoe
Cincinnati	Hamilton	New York	Middlesex	Sacramento	El Dorado
Cincinnati	Kenton	New York	Monmouth	Sacramento	Placer
Cincinnati	Warren	New York	Morris	Sacramento	Sacramento
Fresno	Fresno	New York	Nassau	Sacramento	Yolo
Houston	Brazoria	New York	New York	Salem, OR	Linn
Houston	Fort Bend	New York	Ocean	Salem, OR	Marion
Houston	Galveston	New York	Orange	Salem, OR	Polk
Houston	Harris	New York	Passaic	San Diego	San Diego
Houston	Liberty	New York	Putnam	Santa Barbara	Santa Barbara
Houston	Montgomery	New York	Queens	Visalia	Tulare

TABLE A-2
MODELED NONATTAINMENT AREA COUNTIES
FOR THE 8H5EX-80 STANDARD
UNDER THE REGIONAL CONTROL STRATEGY

NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME
Atlanta, GA	Barrow	Hartford	Hartford	Philadelphia	Burlington
Atlanta, GA	Butts	Hartford	Litchfield	Philadelphia	Camden
Atlanta, GA	Cherokee	Hartford	Middlesex	Philadelphia	Cecil
Atlanta, GA	Clayton	Hartford	Tolland	Philadelphia	Chester
Atlanta, GA	Cobb	Houston	Brazoria	Philadelphia	Cumberland
Atlanta, GA	Coweta	Houston	Fort Bend	Philadelphia	Delaware
Atlanta, GA	De Kalb	Houston	Galveston	Philadelphia	Gloucester
Atlanta, GA	Douglas	Houston	Harris	Philadelphia	Mercer
Atlanta, GA	Fayette	Houston	Liberty	Philadelphia	Montgomery
Atlanta, GA	Forsyth	Houston	Montgomery	Philadelphia	New Castle
Atlanta, GA	Fulton	Houston	Waller	Philadelphia	Philadelphia
Atlanta, GA	Gwinnett	Los Angeles	Los Angeles	Philadelphia	Salem
Atlanta, GA	Henry	Los Angeles	Orange	Phoenix	Maricopa
Atlanta, GA	Morgan	Los Angeles	Riverside	Portland, ME	Cumberland
Atlanta, GA	Newton	Los Angeles	San Bernardino	Portland, ME	York
Atlanta, GA	Paulding	Los Angeles	Ventura	Portland, OR	Clackamas
Atlanta, GA	Putnam	Mariposa, CA	Mariposa	Portland, OR	Clark
Atlanta, GA	Rockdale	Modesto	Stanislaus	Portland, OR	Multnomah
Atlanta, GA	Spalding	Muskegon	Muskegon	Portland, OR	Washington
Atlanta, GA	Walton	Nashville	Cheatham	Portland, OR	Yamhill
Atlantic City	Atlantic	Nashville	Davidson	Providence	Bristol
Atlantic City	Cape May	Nashville	Dickson	Providence	Kent
Bakersfield	Kern	Nashville	Robertson	Providence	Newport
Baltimore	Anne Arundel	Nashville	Rutherford	Providence	Providence
Baltimore	Baltimore	Nashville	Sumner	Redding, CA	Shasta
Baltimore	Baltimore	Nashville	Williamson	Redding, CA	Tehama
Baltimore	Carroll	Nashville	Wilson	Sacramento	El Dorado
Baltimore	Harford	New Haven	New Haven	Sacramento	Placer
Baltimore	Howard	New London	New London	Sacramento	Sacramento
Baltimore	Queen Annes	New London	Washington	Sacramento	Yolo
Baton Rouge, LA	Ascension	New London	Windham	Salem, OR	Linn
Baton Rouge, LA	East Baton Rouge	New York	Bergen	Salem, OR	Marion
Baton Rouge, LA	Iberville	New York	Bronx	Salem, OR	Polk
Baton Rouge, LA	Livingston	New York	Essex	San Diego	San Diego
Baton Rouge, LA	W. Baton Rouge	New York	Hudson	Santa Barbara	Santa Barbara
Bridgeport	Fairfield	New York	Hunterdon	Springfield, MA	Hampden
Cincinnati	Boone	New York	Kings	Springfield, MA	Hampshire
Cincinnati	Butler	New York	Middlesex	Visalia	Tulare
Cincinnati	Campbell	New York	Monmouth	Washington, DC	Alexandria
Cincinnati	Clermont	New York	Morris	Washington, DC	Arlington
Cincinnati	Dearborn	New York	Nassau	Washington, DC	Calvert
Cincinnati	Hamilton	New York	New York	Washington, DC	Charles
Cincinnati	Kenton	New York	Ocean	Washington, DC	Fairfax
Cincinnati	Warren	New York	Orange	Washington, DC	Fairfax
Dallas	Collin	New York	Passaic	Washington, DC	Falls Church
Dallas	Dallas	New York	Putnam	Washington, DC	Frederick

Dallas	Denton	New York	Queens	Washington, DC	Loudoun
Dallas	Ellis	New York	Richmond	Washington, DC	Manassas
Dallas	Johnson	New York	Rockland	Washington, DC	Manassas Park
Dallas	Kaufman	New York	Somerset	Washington, DC	Montgomery
Dallas	Parker	New York	Suffolk	Washington, DC	Prince George's
Dallas	Rockwall	New York	Sussex	Washington, DC	Prince William
Dallas	Tarrant	New York	Union	Washington, DC	Stafford
Fresno	Fresno	New York	Westchester	Washington, DC	Washington
Hancock, KY	Hancock	Philadelphia	Bucks		

TABLE A-3
MODELED NONATTAINMENT AREA COUNTIES
FOR THE 8H4AX-80 STANDARD
UNDER THE REGIONAL CONTROL STRATEGY

NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME
Allegan, MI	Allegan	Dallas	Parker	New York	Richmond
Atlanta, GA	Barrow	Dallas	Rockwall	New York	Rockland
Atlanta, GA	Butts	Dallas	Tarrant	New York	Somerset
Atlanta, GA	Cherokee	Fresno	Fresno	New York	Suffolk
Atlanta, GA	Clayton	Hancock, KY	Hancock	New York	Sussex
Atlanta, GA	Cobb	Hartford	Hartford	New York	Union
Atlanta, GA	Coweta	Hartford	Litchfield	New York	Westchester
Atlanta, GA	De Kalb	Hartford	Middlesex	Philadelphia	Bucks
Atlanta, GA	Douglas	Hartford	Tolland	Philadelphia	Burlington
Atlanta, GA	Fayette	Houston	Brazoria	Philadelphia	Camden
Atlanta, GA	Forsyth	Houston	Fort Bend	Philadelphia	Cecil
Atlanta, GA	Fulton	Houston	Galveston	Philadelphia	Chester
Atlanta, GA	Gwinnett	Houston	Harris	Philadelphia	Cumberland
Atlanta, GA	Henry	Houston	Liberty	Philadelphia	Delaware
Atlanta, GA	Morgan	Houston	Montgomery	Philadelphia	Gloucester
Atlanta, GA	Newton	Houston	Waller	Philadelphia	Mercer
Atlanta, GA	Paulding	Huntington	Boyd	Philadelphia	Montgomery
Atlanta, GA	Putnam	Huntington	Cabell	Philadelphia	New Castle
Atlanta, GA	Rockdale	Huntington	Carter	Philadelphia	Philadelphia
Atlanta, GA	Spalding	Huntington	Greenup	Philadelphia	Salem
Atlanta, GA	Walton	Huntington	Lawrence	Phoenix	Maricopa
Atlantic City	Atlantic	Huntington	Wayne	Portland, ME	Cumberland
Atlantic City	Cape May	Knox, ME	Knox	Portland, ME	York
Bakersfield	Kern	Knoxville	Anderson	Portland, OR	Clackamas
Baltimore	Anne Arundel	Knoxville	Blount	Portland, OR	Clark
Baltimore	Baltimore	Knoxville	Grainger	Portland, OR	Multnomah
Baltimore	Baltimore	Knoxville	Jefferson	Portland, OR	Washington
Baltimore	Carroll	Knoxville	Knox	Portland, OR	Yamhill
Baltimore	Harford	Knoxville	Sevier	Providence	Bristol
Baltimore	Howard	Knoxville	Union	Providence	Kent
Baltimore	Queen Annes	Los Angeles	Los Angeles	Providence	Newport
Baton Rouge	Ascension	Los Angeles	Orange	Providence	Providence
Baton Rouge	East Baton Rouge	Los Angeles	Riverside	Redding, CA	Shasta
Baton Rouge	Iberville	Los Angeles	San Bernardino	Redding, CA	Tehama
Baton Rouge	Livingston	Los Angeles	Ventura	Sacramento	El Dorado
Baton Rouge	W. Baton Rouge	Mariposa, CA	Mariposa	Sacramento	Placer
Beaumont	Hardin	Modesto	Stanislaus	Sacramento	Sacramento
Beaumont	Jefferson	Muskegon	Muskegon	Sacramento	Yolo
Beaumont	Orange	Nashville	Cheatham	Salem, OR	Linn
Bridgeport	Fairfield	Nashville	Davidson	Salem, OR	Marion
Chicago	Cook	Nashville	Dickson	Salem, OR	Polk
Chicago	Du Page	Nashville	Robertson	San Diego	San Diego
Chicago	Grundy	Nashville	Rutherford	Santa Barbara	Santa Barbara
Chicago	Jasper	Nashville	Sumner	Seattle	King
Chicago	Kane	Nashville	Williamson	Seattle	Pierce
Chicago	Kendall	Nashville	Wilson	Seattle	Snohomish

Chicago	Kenosha	New Haven	New Haven	Springfield, MA	Hampden
Chicago	Lake	New London	New London	Springfield, MA	Hampshire
Chicago	Lake	New London	Washington	Visalia	Tulare
Chicago	McHenry	New London	Windham	Washington, DC	Alexandria
Chicago	Porter	New York	Bergen	Washington, DC	Arlington
Chicago	Will	New York	Bronx	Washington, DC	Calvert
Cincinnati	Boone	New York	Essex	Washington, DC	Charles
Cincinnati	Butler	New York	Hudson	Washington, DC	Fairfax
Cincinnati	Campbell	New York	Hunterdon	Washington, DC	Fairfax
Cincinnati	Clermont	New York	Kings	Washington, DC	Falls Church
Cincinnati	Dearborn	New York	Middlesex	Washington, DC	Frederick
Cincinnati	Hamilton	New York	Monmouth	Washington, DC	Loudoun
Cincinnati	Kenton	New York	Morris	Washington, DC	Manassas
Cincinnati	Warren	New York	Nassau	Washington, DC	Manassas Park
Dallas	Collin	New York	New York	Washington, DC	Montgomery
Dallas	Dallas	New York	Ocean	Washington, DC	Prince George's
Dallas	Denton	New York	Orange	Washington, DC	Prince William
Dallas	Ellis	New York	Passaic	Washington, DC	Stafford
Dallas	Johnson	New York	Putnam	Washington, DC	Washington
Dallas	Kaufman	New York	Queens		

TABLE A-4
MODELED NONATTAINMENT AREA COUNTIES FOR THE 8H1AX-80 STANDARD UNDER THE REGIONAL CONTROL STRATEGY

NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME
Allentown	Carbon	Detroit	Livingston	New York	Rockland
Allentown	Lehigh	Detroit	Macomb	New York	Somerset
Allentown	Northampton	Detroit	Monroe	New York	Suffolk
Allentown	Warren	Detroit	Oakland	New York	Sussex
Athens, GA	Clarke	Detroit	St. Clair	New York	Union
Athens, GA	Greene	Detroit	Washtenaw	New York	Westchester
Athens, GA	Jackson	Detroit	Wayne	Philadelphia	Bucks
Athens, GA	Madison	Douglas, WA	Douglas	Philadelphia	Burlington
Athens, GA	Oconee	Eugene, OR	Douglas	Philadelphia	Camden
Atlanta, GA	Baldwin	Eugene, OR	Lane	Philadelphia	Cecil
Atlanta, GA	Barrow	Fresno	Fresno	Philadelphia	Chester
Atlanta, GA	Bartow	Fresno	Kings	Philadelphia	Cumberland
Atlanta, GA	Bleckley	Fresno	Madera	Philadelphia	Delaware
Atlanta, GA	Butts	Fresno	Mariposa	Philadelphia	Gloucester
Atlanta, GA	Cherokee	Fresno	San Benito	Philadelphia	Mercer
Atlanta, GA	Clayton	Grand Rapids,	Allegan	Philadelphia	Montgomery
Atlanta, GA	Cobb	Grand Rapids,	Kent	Philadelphia	New Castle
Atlanta, GA	Coweta	Grand Rapids,	Ottawa	Philadelphia	Philadelphia
Atlanta, GA	De Kalb	Greensboro	Davidson	Philadelphia	Salem
Atlanta, GA	Douglas	Greensboro	Davie	Phoenix	Maricopa
Atlanta, GA	Fayette	Greensboro	Forsyth	Pittsburgh	Allegheny
Atlanta, GA	Forsyth	Greensboro	Guilford	Pittsburgh	Beaver
Atlanta, GA	Fulton	Greensboro	Randolph	Pittsburgh	Fayette
Atlanta, GA	Gwinnett	Greensboro	Stokes	Pittsburgh	Washington
Atlanta, GA	Henry	Greensboro	Yadkin	Pittsburgh	Westmoreland
Atlanta, GA	Laurens	Hancock, ME	Hancock	Portland, ME	Cumberland
Atlanta, GA	Morgan	Harrisburg	Cumberland	Portland, ME	York
Atlanta, GA	Newton	Harrisburg	Dauphin	Portland, OR	Clackamas
Atlanta, GA	Paulding	Harrisburg	Franklin	Portland, OR	Clark
Atlanta, GA	Putnam	Harrisburg	Lebanon	Portland, OR	Multnomah
Atlanta, GA	Rockdale	Harrisburg	Perry	Portland, OR	Washington
Atlanta, GA	Spalding	Hartford	Hartford	Portland, OR	Yamhill
Atlanta, GA	Walton	Hartford	Litchfield	Providence	Bristol
Atlanta, GA	Wilkinson	Hartford	Middlesex	Providence	Kent
Atlanta, GA	Atlantic	Hartford	Tolland	Providence	Newport
Atlanta, GA	Cape May	Hopkins, TX	Hopkins	Providence	Providence
Austin, TX	Hays	Houston	Austin	Raleigh-Durham	Durham
Austin, TX	Travis	Houston	Brazoria	Raleigh-Durham	Franklin
Austin, TX	Williamson	Houston	Fort Bend	Raleigh-Durham	Orange
Bakersfield, CA	Kern	Houston	Galveston	Raleigh-Durham	Wake
Baltimore	Anne Arundel	Houston	Harris	Reading, PA	Berks
Baltimore	Baltimore	Houston	Liberty	Redding, CA	Shasta
Baltimore	Baltimore	Houston	Montgomery	Redding, CA	Tehama
Baltimore	Caroline	Houston	Walker	Reno	Washoe
Baltimore	Carroll	Houston	Waller	Richmond	Charles City
Baltimore	Harford	Houston	Wharton	Richmond	Chesterfield
Baltimore	Howard	Huntington	Boyd	Richmond	Colonial Heights

Baltimore	Kent	Huntington	Cabell	Richmond	Dinwiddie
Baltimore	Queen Annes	Huntington	Carter	Richmond	Goochland
Baltimore	Sussex	Huntington	Greenup	Richmond	Hanover
Baltimore	Talbot	Huntington	Lawrence	Richmond	Henrico
Baltimore	Wicomico	Huntington	Wayne	Richmond	Hopewell
Barnwell, SC	Barnwell	Indianapolis	Boone	Richmond	New Kent
Baton Rouge, LA	Ascension	Indianapolis	Hamilton	Richmond	Petersburg
Baton Rouge, LA	East Baton Rouge	Indianapolis	Hancock	Richmond	Powhatan
Baton Rouge, LA	Iberville	Indianapolis	Hendricks	Richmond	Prince George
Baton Rouge, LA	Livingston	Indianapolis	Johnson	Richmond	Richmond
Baton Rouge, LA	W. Baton Rouge	Indianapolis	Marion	Rochester, NY	Livingston
Beaumont, TX	Hardin	Indianapolis	Morgan	Rochester, NY	Monroe
Beaumont, TX	Jefferson	Indianapolis	Shelby	Rochester, NY	Ontario
Beaumont, TX	Orange	Johnson City	Bristol	Rochester, NY	Orleans
Birmingham, AL	Blount	Johnson City	Carter	Rochester, NY	Wayne
Birmingham, AL	Jefferson	Johnson City	Hawkins	Sacramento	El Dorado
Birmingham, AL	Shelby	Johnson City	Scott	Sacramento	Nevada
Birmingham, AL	St. Clair	Johnson City	Sullivan	Sacramento	Placer
Birmingham, AL	Walker	Johnson City	Unicoi	Sacramento	Sacramento
Boston, MA	Barnstable	Johnson City	Washington	Sacramento	Yolo
Boston, MA	Middlesex	Johnson City	Washington	Salem, OR	Benton
Boston, MA	Norfolk	Knox, ME	Knox	Salem, OR	Jefferson
Boston, MA	Plymouth	Knoxville	Anderson	Salem, OR	Lincoln
Boston, MA	Suffolk	Knoxville	Blount	Salem, OR	Linn
Bridgeport	Fairfield	Knoxville	Campbell	Salem, OR	Marion
Charlotte	Cabarrus	Knoxville	Grainger	Salem, OR	Polk
Charlotte	Gaston	Knoxville	Jefferson	San Diego	San Diego
Charlotte	Lincoln	Knoxville	Knox	San Francisco	Alameda
Charlotte	Mecklenburg	Knoxville	Sevier	San Francisco	Contra Costa
Charlotte	Rowan	Knoxville	Union	San Francisco	Marin
Charlotte	Union	Los Angeles	Los Angeles	San Francisco	Napa
Charlotte	York	Los Angeles	Orange	San Francisco	San Francisco
Chattanooga, TN	Catoosa	Los Angeles	Riverside	San Francisco	San Mateo
Chattanooga, TN	Dade	Los Angeles	San Bernardino	San Francisco	Santa Clara
Chattanooga, TN	De Kalb	Los Angeles	Ventura	San Francisco	Santa Cruz
Chattanooga, TN	Hamilton	Louisville	Bullitt	San Francisco	Solano
Chattanooga, TN	Marion	Louisville	Clark	San Francisco	Sonoma
Chattanooga, TN	Sequatchie	Louisville	Floyd	Santa Barbara	Santa Barbara
Chattanooga, TN	Walker	Louisville	Harrison	Seattle	King
Chattanooga, TN	Whitfield	Louisville	Jefferson	Seattle	Lewis
Chicago, IL	Cook	Louisville	Oldham	Seattle	Pierce
Chicago, IL	Du Page	Louisville	Shelby	Seattle	Snohomish
Chicago, IL	Grundy	Manitowoc, WI	Door	Shreveport, LA	Bossier
Chicago, IL	Jasper	Manitowoc, WI	Kewaunee	Shreveport, LA	Caddo
Chicago, IL	Kane	Manitowoc, WI	Manitowoc	Springfield, MA	Hampden
Chicago, IL	Kendall	Marshall, OK	Marshall	Springfield, MA	Hampshire
Chicago, IL	Kenosha	Memphis	Crittenden	St. Louis	Bond
Chicago, IL	Lake	Memphis	De Soto	St. Louis	Clinton
Chicago, IL	Lake	Memphis	Shelby	St. Louis	Franklin
Chicago, IL	McHenry	Memphis	Tipton	St. Louis	Jefferson
Chicago, IL	Porter	Milwaukee	Milwaukee	St. Louis	Jersey
Chicago, IL	Will	Milwaukee	Ozaukee	St. Louis	Madison
Cincinnati, OH	Boone	Milwaukee	Racine	St. Louis	Monroe

Cincinnati, OH	Butler	Milwaukee	Washington	St. Louis	St. Charles
Cincinnati, OH	Campbell	Milwaukee	Waukesha	St. Louis	St. Clair
Cincinnati, OH	Clermont	Modesto	Stanislaus	St. Louis	St. Louis
Cincinnati, OH	Clinton	Modesto	Tuolumne	St. Louis	St. Louis
Cincinnati, OH	Dearborn	Muskegon	Muskegon	State College, PA	Centre
Cincinnati, OH	Hamilton	Nashville	Cheatham	Stockton, CA	San Joaquin
Cincinnati, OH	Kenton	Nashville	Davidson	Tell City	Hancock
Cincinnati, OH	Warren	Nashville	Dickson	Tell City	Perry
Cleveland, OH	Cuyahoga	Nashville	Robertson	Tell City	Spencer
Cleveland, OH	Geauga	Nashville	Rutherford	Tulsa, OK	Creek
Cleveland, OH	Lake	Nashville	Sumner	Tulsa, OK	Osage
Cleveland, OH	Lorain	Nashville	Williamson	Tulsa, OK	Rogers
Cleveland, OH	Medina	Nashville	Wilson	Tulsa, OK	Tulsa
Cleveland, OH	Portage	New Bedford	Bristol	Tulsa, OK	Wagoner
Cleveland, OH	Summit	New Haven	New Haven	Tulsa, OK	Washington
Columbia, SC	Lexington	New London	New London	Visalia	Tulare
Columbia, SC	Richland	New London	Washington	Washington, DC	Alexandria
Columbus, OH	Delaware	New London	Windham	Washington, DC	Arlington
Columbus, OH	Fairfield	New Orleans	Jefferson	Washington, DC	Calvert
Columbus, OH	Fayette	New Orleans	Orleans	Washington, DC	Charles
Columbus, OH	Franklin	New Orleans	St. Bernard	Washington, DC	Fairfax
Columbus, OH	Licking	New Orleans	St. Charles	Washington, DC	Fairfax
Columbus, OH	Madison	New Orleans	St. John The Bap.	Washington, DC	Falls Church
Columbus, OH	Pickaway	New Orleans	St. Tammany	Washington, DC	Frederick
Columbus, OH	Union	New York	Bergen	Washington, DC	King George
Dallas	Collin	New York	Bronx	Washington, DC	Loudoun
Dallas	Dallas	New York	Essex	Washington, DC	Manassas
Dallas	Denton	New York	Hudson	Washington, DC	Manassas Park
Dallas	Ellis	New York	Hunterdon	Washington, DC	Montgomery
Dallas	Johnson	New York	Kings	Washington, DC	Prince George's
Dallas	Kaufman	New York	Middlesex	Washington, DC	Prince William
Dallas	Montague	New York	Monmouth	Washington, DC	Stafford
Dallas	Parker	New York	Morris	Washington, DC	Washington
Dallas	Rockwall	New York	Nassau	Willis Wharf, VA	Accomack
Dallas	Tarrant	New York	New York	Willis Wharf, VA	Northampton
Dallas	Wise	New York	Ocean	York, PA	Adams
Dayton	Clark	New York	Orange	York, PA	York
Dayton	Greene	New York	Passaic	Yuba City, CA	Sutter
Dayton	Miami	New York	Putnam	Yuba City, CA	Yuba
Dayton	Montgomery	New York	Queens		
Detroit	Lapeer	New York	Richmond		

TABLE A-5
MODELED NONATTAINMENT AREA COUNTIES FOR THE CURRENT STANDARD UNDER THE LOCAL CONTROL STRATEGY

NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME
Abilene, TX	Callahan	Grand Rapids, MI	Barry	Orlando, FL	Orange
Abilene, TX	Taylor	Grand Rapids, MI	Newaygo	Orlando, FL	Seminole
Albany, NY	Albany	Grand Rapids, MI	Manistee	Orlando, FL	Lake
Albany, NY	Saratoga	Green Bay, WI	Manitowoc	Orlando, FL	Osceola
Albany, NY	Rensselaer	Green Bay, WI	Door	Owensboro, KY	Daviess
Albany, NY	Schenectady	Green Bay, WI	Kewaunee	Owensboro, KY	Hancock
Albany, NY	Montgomery	Green Bay, WI	Brown	Parkersburg, WV	Wood
Albany, NY	Schoharie	Greensboro, NC	Guilford	Parkersburg, WV	Washington
Allentown, PA	Lehigh	Greensboro, NC	Forsyth	Parkersburg, WV	Athens
Allentown, PA	Northampton	Greensboro, NC	Alamance	Parkersburg, WV	Jackson
Allentown, PA	Carbon	Greensboro, NC	Rockingham	Parkersburg, WV	Meigs
Altoona, PA	Blair	Greensboro, NC	Surry	Parkersburg, WV	Morgan
Athens, GA	Clarke	Greensboro, NC	Yadkin	Parkersburg, WV	Noble
Athens, GA	Oconee	Greensboro, NC	Davie	Parkersburg, WV	Gilmer
Athens, GA	Greene	Greensboro, NC	Patrick	Parkersburg, WV	Wirt
Athens, GA	Madison	Greensboro, NC	Davidson	Pensacola, FL	Escambia
Atlanta, GA	Fulton	Greensboro, NC	Randolph	Pensacola, FL	Santa Rosa
Atlanta, GA	De Kalb	Greensboro, NC	Stokes	Philadelphia, PA	Philadelphi
Atlanta, GA	Cobb	Greenville, SC	Greenville	Philadelphia, PA	Montgomery
Atlanta, GA	Gwinnett	Greenville, SC	Spartanburg	Philadelphia, PA	Delaware
Atlanta, GA	Clayton	Greenville, SC	Anderson	Philadelphia, PA	Bucks
Atlanta, GA	Floyd	Greenville, SC	Pickens	Philadelphia, PA	Camden
Atlanta, GA	Douglas	Greenville, SC	Cherokee	Philadelphia, PA	New Castle
Atlanta, GA	Fayette	Harrisburg, PA	Dauphin	Philadelphia, PA	Burlington
Atlanta, GA	Henry	Harrisburg, PA	Cumberland	Philadelphia, PA	Chester
Atlanta, GA	Bartow	Harrisburg, PA	Lebanon	Philadelphia, PA	Gloucester
Atlanta, GA	Spalding	Harrisburg, PA	Perry	Philadelphia, PA	Atlantic
Atlanta, GA	Rockdale	Hartford, CT	Hartford	Philadelphia, PA	Cumberland
Atlanta, GA	Coweta	Hartford, CT	Middlesex	Philadelphia, PA	Cape May
Atlanta, GA	Newton	Hartford, CT	Tolland	Philadelphia, PA	Cecil
Atlanta, GA	Paulding	Hickory, NC	Wilkes	Philadelphia, PA	Salem
Atlanta, GA	Walton	Hickory, NC	Catawba	Phoenix, AZ	Maricopa
Atlanta, GA	Gordon	Hickory, NC	Burke	Phoenix, AZ	Pinal
Atlanta, GA	Polk	Hickory, NC	Caldwell	Pittsburgh, PA	Allegheny
Atlanta, GA	Jackson	Hickory, NC	Alexander	Pittsburgh, PA	Westmorelan
Atlanta, GA	Barrow	Houston, TX	Harris	Pittsburgh, PA	Washington
Atlanta, GA	Meriwether	Houston, TX	Fort Bend	Pittsburgh, PA	Butler
Atlanta, GA	Haralson	Houston, TX	Galveston	Pittsburgh, PA	Fayette
Atlanta, GA	Butts	Houston, TX	Brazoria	Pittsburgh, PA	Armstrong
Atlanta, GA	Gilmer	Houston, TX	Montgomery	Pittsburgh, PA	Clarion
Atlanta, GA	Morgan	Houston, TX	Walker	Pittsburgh, PA	Tucker
Atlanta, GA	Cleburne	Houston, TX	Wharton	Pittsburgh, PA	Forest
Atlanta, GA	Pike	Houston, TX	Matagorda	Pittsburgh, PA	Beaver
Atlanta, GA	Cherokee	Houston, TX	Polk	Pittsfield, MA	Berkshire
Atlanta, GA	Carroll	Houston, TX	Waller	Portland, ME	Cumberland
Atlanta, GA	Forsyth	Houston, TX	Austin	Portland, OR	Clackamas
Atlanta, GA	Pickens	Houston, TX	Trinity	Portland, OR	Marion
Augusta, GA	Aiken	Houston, TX	Liberty	Portland, OR	Linn

Augusta, GA	Barnwell	Houston, TX	Chambers	Portland, OR	Benton
Augusta, GA	McDuffie	Huntington, WV	Cabell	Portland, OR	Lincoln
Augusta, GA	Washington	Huntington, WV	Scioto	Portland, OR	Jefferson
Augusta, GA	Bamberg	Huntington, WV	Lawrence	Portland, OR	Multnomah
Augusta, GA	Allendale	Huntington, WV	Boyd	Portland, OR	Washington
Augusta, GA	Glascock	Huntington, WV	Greenup	Portland, OR	Clark
Augusta, GA	Taliaferro	Huntington, WV	Gallia	Portland, OR	Yamhill
Augusta, GA	Richmond	Huntington, WV	Jackson	Portland, OR	Polk
Augusta, GA	Columbia	Huntington, WV	Pike	Portland, OR	Columbia
Augusta, GA	Edgefield	Huntington, WV	Johnson	Providence, RI	Providence
Austin, TX	Travis	Huntington, WV	Lawrence	Providence, RI	Kent
Austin, TX	Williamson	Huntington, WV	Martin	Providence, RI	Washington
Austin, TX	Burnet	Huntington, WV	Wayne	Providence, RI	Newport
Austin, TX	Hays	Huntington, WV	Carter	Providence, RI	Bristol
Austin, TX	Bastrop	Indianapolis, IN	Marion	Raleigh, NC	Wake
Austin, TX	Caldwell	Indianapolis, IN	Madison	Raleigh, NC	Durham
Bakersfield, CA	Kern	Indianapolis, IN	Hamilton	Raleigh, NC	Orange
Bangor, ME	Kennebec	Indianapolis, IN	Bartholomew	Raleigh, NC	Johnston
Bangor, ME	Hancock	Indianapolis, IN	Morgan	Raleigh, NC	Harnett
Bangor, ME	Knox	Indianapolis, IN	Hancock	Raleigh, NC	Granville
Bangor, ME	Waldo	Indianapolis, IN	Decatur	Raleigh, NC	Person
Bangor, ME	Lincoln	Indianapolis, IN	Rush	Raleigh, NC	Chatham
Bangor, ME	Penobscot	Indianapolis, IN	Johnson	Raleigh, NC	Franklin
Barnstable, MA	Barnstable	Indianapolis, IN	Hendricks	Redding, PA	Berks
Barnstable, MA	Nantucket	Indianapolis, IN	Shelby	Redding, CA	Shasta
Baton Rouge, LA	East Baton	Indianapolis, IN	Boone	Redding, CA	Tehama
Baton Rouge, LA	Ascension	Johnson City, TN	Sullivan	Reno, NV	Washoe
Baton Rouge, LA	Iberville	Johnson City, TN	Washington	Richmond, VA	Henrico
Baton Rouge, LA	Pointe Coup	Johnson City, TN	Carter	Richmond, VA	Chesterfiel
Baton Rouge, LA	West Baton	Johnson City, TN	Tazewell	Richmond, VA	Richmond
Baton Rouge, LA	East Felici	Johnson City, TN	Washington	Richmond, VA	Petersburg
Baton Rouge, LA	Livingston	Johnson City, TN	Hawkins	Richmond, VA	Prince Geor
Beaumont, TX	Jefferson	Johnson City, TN	Smyth	Richmond, VA	Hopewell
Beaumont, TX	Orange	Johnson City, TN	Russell	Richmond, VA	Dinwiddie
Beaumont, TX	Hardin	Johnson City, TN	Scott	Richmond, VA	Prince Edwa
Biloxi, MS	Harrison	Johnson City, TN	Bristol	Richmond, VA	Colonial He
Biloxi, MS	Jackson	Johnson City, TN	Dickenson	Richmond, VA	New Kent
Biloxi, MS	Hancock	Johnson City, TN	Avery	Richmond, VA	Sussex
Birmingham, AL	Jefferson	Johnson City, TN	Mitchell	Richmond, VA	Greensville
Birmingham, AL	Shelby	Johnson City, TN	Unicoi	Richmond, VA	Charles Cit
Birmingham, AL	St. Clair	Johnstown, PA	Cambria	Richmond, VA	Hanover
Birmingham, AL	Blount	Johnstown, PA	Somerset	Richmond, VA	Powhatan
Bloomington, IN	Monroe	Johnstown, PA	Jefferson	Richmond, VA	Goochland
Bloomington, IN	Lawrence	Joplin, MO	Neosho	Rochester, NY	Monroe
Bloomington, IN	Martin	Joplin, MO	Jasper	Rochester, NY	Ontario
Boston, MA	Middlesex	Joplin, MO	Newton	Rochester, NY	Wayne
Boston, MA	Norfolk	Knoxville, TN	Knox	Rochester, NY	Genesee
Boston, MA	Bristol	Knoxville, TN	Blount	Rochester, NY	Wyoming
Boston, MA	York	Knoxville, TN	Anderson	Rochester, NY	Orleans
Boston, MA	Worcester	Knoxville, TN	Sevier	Rochester, NY	Yates
Boston, MA	Essex	Knoxville, TN	Campbell	Rochester, NY	Livingston
Boston, MA	Suffolk	Knoxville, TN	Cumberland	Rocky Mount, NC	Edgecombe
Boston, MA	Plymouth	Knoxville, TN	Whitley	Rocky Mount, NC	Northampton
Boston, MA	Hillsboroug	Knoxville, TN	Jefferson	Rocky Mount, NC	Nash
Boston, MA	Rockingham	Knoxville, TN	Bell	Sacramento, CA	Sacramento
Boston, MA	Merrimack	Knoxville, TN	Loudon	Sacramento, CA	Placer

Boston, MA	Strafford	Knoxville, TN	Claiborne	Sacramento, CA	Nevada
Buffalo, NY	Erie	Knoxville, TN	Scott	Sacramento, CA	Yolo
Buffalo, NY	Niagara	Knoxville, TN	Grainger	Sacramento, CA	El Dorado
Canton, OH	Stark	Knoxville, TN	McCreary	St Louis, MO	St. Louis
Canton, OH	Carroll	Knoxville, TN	Union	St Louis, MO	St. Louis
Champaign, IL	Champaign	Kokomo, IN	Tipton	St Louis, MO	Madison
Charleston, WV	Mason	Kokomo, IN	Howard	St Louis, MO	St. Charles
Charleston, WV	Roane	Lafayette, IN	Tippecanoe	St Louis, MO	Macoupin
Charleston, WV	Kanawha	Lafayette, IN	Clinton	St Louis, MO	Jersey
Charleston, WV	Putnam	Lancaster, PA	Lancaster	St Louis, MO	Greene
Charlotte, NC	Mecklenburg	Lawton, OK	Greer	St Louis, MO	Bond
Charlotte, NC	York	Lawton, OK	Comanche	St Louis, MO	Washington
Charlotte, NC	Rowan	Lewiston, ME	Sagadahoc	St Louis, MO	St. Clair
Charlotte, NC	Cabarrus	Lewiston, ME	Androscoggi	St Louis, MO	Jefferson
Charlotte, NC	Stanly	Lexington, KY	Fayette	St Louis, MO	Franklin
Charlotte, NC	Chester	Lexington, KY	Pulaski	St Louis, MO	Clinton
Charlotte, NC	Gaston	Lexington, KY	Franklin	St Louis, MO	Lincoln
Charlotte, NC	Union	Lexington, KY	Jessamine	St Louis, MO	Monroe
Charlotte, NC	Lincoln	Lexington, KY	Boyle	St Louis, MO	Warren
Chattanooga, TN	Hamilton	Lexington, KY	Lincoln	St Louis, MO	Crawford
Chattanooga, TN	Bradley	Lexington, KY	Woodford	Salinas, CA	San Benito
Chattanooga, TN	Whitfield	Lexington, KY	Mercer	Salinas, CA	Monterey
Chattanooga, TN	Walker	Lexington, KY	Anderson	San Diego, CA	San Diego
Chattanooga, TN	Catoosa	Lexington, KY	Garrard	San Francisco, CA	Alameda
Chattanooga, TN	Murray	Lexington, KY	Madison	San Francisco, CA	Contra Cost
Chattanooga, TN	Chattooga	Lexington, KY	Clark	San Francisco, CA	Santa Clara
Chattanooga, TN	Dade	Lexington, KY	Scott	San Francisco, CA	San Francis
Chattanooga, TN	Marion	Lexington, KY	Bourbon	San Francisco, CA	San Mateo
Chicago, IL	Lake	Lima, OH	Auglaize	San Francisco, CA	Sonoma
Chicago, IL	Porter	Lima, OH	Logan	San Francisco, CA	Solano
Chicago, IL	Kenosha	Lima, OH	Allen	San Francisco, CA	Marin
Chicago, IL	La Porte	Longview, TX	Gregg	San Francisco, CA	Santa Cruz
Chicago, IL	Jasper	Longview, TX	Titus	San Francisco, CA	Napa
Chicago, IL	Cook	Longview, TX	Franklin	Santa Barbara, CA	Santa Barba
Chicago, IL	Du Page	Longview, TX	Harrison	Savannah, GA	Toombs
Chicago, IL	Lake	Longview, TX	Upshur	Savannah, GA	Appling
Chicago, IL	Will	Los Angeles, CA	Los Angeles	Savannah, GA	Jeff Davis
Chicago, IL	Kane	Los Angeles, CA	Orange	Savannah, GA	Chatham
Chicago, IL	McHenry	Los Angeles, CA	San Bernard	Savannah, GA	Effingham
Chicago, IL	Kankakee	Los Angeles, CA	Riverside	Savannah, GA	Bryan
Chicago, IL	De Kalb	Los Angeles, CA	Ventura	Scranton, PA	Luzerne
Chicago, IL	Kendall	Louisville, KY	Clark	Scranton, PA	Schuylkill
Chicago, IL	Grundy	Louisville, KY	Jackson	Scranton, PA	Susquehanna
Cincinnati, OH	Hamilton	Louisville, KY	Oldham	Scranton, PA	Lackawanna
Cincinnati, OH	Butler	Louisville, KY	Meade	Scranton, PA	Columbia
Cincinnati, OH	Clermont	Louisville, KY	Washington	Scranton, PA	Wyoming
Cincinnati, OH	Warren	Louisville, KY	Jennings	Seattle, WA	King
Cincinnati, OH	Campbell	Louisville, KY	Scott	Seattle, WA	Pierce
Cincinnati, OH	Boone	Louisville, KY	Perry	Seattle, WA	Lewis
Cincinnati, OH	Highland	Louisville, KY	Orange	Seattle, WA	Douglas
Cincinnati, OH	Clinton	Louisville, KY	Breckinridg	Seattle, WA	Snohomish
Cincinnati, OH	Ripley	Louisville, KY	Crawford	Seattle, WA	Kitsap
Cincinnati, OH	Franklin	Louisville, KY	Trimble	Seattle, WA	Thurston
Cincinnati, OH	Grant	Louisville, KY	Jefferson	Seattle, WA	Island
Cincinnati, OH	Carroll	Louisville, KY	Floyd	Sharon, PA	Mercer
Cincinnati, OH	Switzerland	Louisville, KY	Bullitt	Sharon, PA	Venango

Cincinnati, OH	Union	Louisville, KY	Harrison	Sheboygan, WI	Sheboygan
Cincinnati, OH	Kenton	Macon, GA	Bibb	Sherman, TX	Grayson
Cincinnati, OH	Dearborn	Macon, GA	Laurens	Sherman, TX	Marshall
Cincinnati, OH	Brown	Macon, GA	Baldwin	Sherman, TX	Johnston
Cincinnati, OH	Pendleton	Macon, GA	Putnam	Sherman, TX	Love
Cincinnati, OH	Gallatin	Macon, GA	Bleckley	Shreveport, LA	Bossier
Cincinnati, OH	Ohio	Macon, GA	Wilkinson	Shreveport, LA	De Soto
Cleveland, OH	Cuyahoga	Macon, GA	Twiggs	Shreveport, LA	Red River
Cleveland, OH	Summit	Macon, GA	Johnson	Shreveport, LA	Caddo
Cleveland, OH	Lake	Macon, GA	Montgomery	Shreveport, LA	Webster
Cleveland, OH	Portage	Macon, GA	Treutlen	Springfield, MA	Hampden
Cleveland, OH	Ashtabula	Macon, GA	Wheeler	Springfield, MA	Hampshire
Cleveland, OH	Crawford	Macon, GA	Houston	Springfield, MA	Franklin
Cleveland, OH	Lorain	Macon, GA	Peach	State College, PA	Centre
Cleveland, OH	Medina	Macon, GA	Jones	State College, PA	Clearfield
Cleveland, OH	Geauga	Memphis, TN	Shelby	State College, PA	Elk
Columbia, SC	Richland	Memphis, TN	De Soto	Stockton, CA	San Joaquin
Columbia, SC	Lexington	Memphis, TN	Tipton	Syracuse, NY	Onondaga
Columbia, SC	Fairfield	Memphis, TN	Tate	Syracuse, NY	Cayuga
Columbia, SC	Calhoun	Memphis, TN	Crittenden	Syracuse, NY	Madison
Columbus, GA	Marion	Memphis, TN	Fayette	Syracuse, NY	Seneca
Columbus, GA	Muscogee	Milwaukee, WI	Milwaukee	Syracuse, NY	Oswego
Columbus, GA	Russell	Milwaukee, WI	Waukesha	Tampa, FL	Pinellas
Columbus, GA	Harris	Milwaukee, WI	Racine	Tampa, FL	Hillsboroug
Columbus, GA	Chattahooch	Milwaukee, WI	Ozaukee	Tampa, FL	Pasco
Columbus, OH	Franklin	Milwaukee, WI	Washington	Tampa, FL	Hernando
Columbus, OH	Licking	Mobile, AL	Mobile	Terre Haute, IN	Vigo
Columbus, OH	Fairfield	Mobile, AL	Baldwin	Terre Haute, IN	Owen
Columbus, OH	Muskingum	Modesto, CA	Stanislaus	Terre Haute, IN	Clay
Columbus, OH	Ross	Muncie, IN	Delaware	Terre Haute, IN	Vermillion
Columbus, OH	Pickaway	Muncie, IN	Blackford	Texarkana, AR	Red River
Columbus, OH	Knox	Nashville, TN	Sumner	Texarkana, AR	Bowie
Columbus, OH	Madison	Nashville, TN	Williamson	Texarkana, AR	Miller
Columbus, OH	Union	Nashville, TN	Wilson	Tulsa, OK	Tulsa
Columbus, OH	Fayette	Nashville, TN	Maury	Tulsa, OK	Rogers
Columbus, OH	Vinton	Nashville, TN	Robertson	Tulsa, OK	Washington
Columbus, OH	Delaware	Nashville, TN	Barren	Tulsa, OK	Wagoner
Dallas, TX	Dallas	Nashville, TN	Logan	Tulsa, OK	Osage
Dallas, TX	Tarrant	Nashville, TN	Macon	Tulsa, OK	Montgomery
Dallas, TX	Denton	Nashville, TN	Simpson	Tulsa, OK	Labette
Dallas, TX	Collin	Nashville, TN	Cannon	Tulsa, OK	Pawnee
Dallas, TX	Johnson	Nashville, TN	Davidson	Tulsa, OK	Chautauqua
Dallas, TX	Hunt	Nashville, TN	Rutherford	Tulsa, OK	Creek
Dallas, TX	Lamar	Nashville, TN	Dickson	Utica, NY	Oneida
Dallas, TX	Wise	Nashville, TN	Cheatham	Utica, NY	Herkimer
Dallas, TX	Cooke	New London, CT	New London	Visalia, CA	Tulare
Dallas, TX	Hopkins	New London, CT	Windham	Washington, DC	Fairfax
Dallas, TX	Rockwall	New Orleans, LA	St. Tammany	Washington, DC	Montgomery
Dallas, TX	Palo Pinto	New Orleans, LA	Orleans	Washington, DC	Baltimore
Dallas, TX	Houston	New Orleans, LA	Jefferson	Washington, DC	Prince Geor
Dallas, TX	Eastland	New Orleans, LA	St. Bernard	Washington, DC	Baltimore
Dallas, TX	Montague	New Orleans, LA	St. Charles	Washington, DC	Washington
Dallas, TX	Delta	New Orleans, LA	St. John Th	Washington, DC	Anne Arunde
Dallas, TX	Ellis	New Orleans, LA	Plaquemines	Washington, DC	Prince Will
Dallas, TX	Parker	New Orleans, LA	St. James	Washington, DC	Howard
Dallas, TX	Henderson	New York, NY	Kings	Washington, DC	Harford

Dallas, TX	Kaufman	New York, NY	Queens	Washington, DC	Arlington
Dallas, TX	Hood	New York, NY	New York	Washington, DC	Frederick
Dayton, OH	Montgomery	New York, NY	Suffolk	Washington, DC	Carroll
Dayton, OH	Clark	New York, NY	Nassau	Washington, DC	Franklin
Dayton, OH	Greene	New York, NY	Bronx	Washington, DC	Alexandria
Dayton, OH	Miami	New York, NY	Westchester	Washington, DC	Charles
Dayton, OH	Preble	New York, NY	Fairfield	Washington, DC	Loudoun
Dayton, OH	Champaign	New York, NY	Bergen	Washington, DC	Adams
Detroit, MI	Oakland	New York, NY	New Haven	Washington, DC	Calvert
Detroit, MI	Macomb	New York, NY	Essex	Washington, DC	Queen Annes
Detroit, MI	Washtenaw	New York, NY	Middlesex	Washington, DC	Talbot
Detroit, MI	St. Clair	New York, NY	Monmouth	Washington, DC	Dorchester
Detroit, MI	Livingston	New York, NY	Hudson	Washington, DC	Manassas
Detroit, MI	Lapeer	New York, NY	Union	Washington, DC	Caroline
Detroit, MI	Wayne	New York, NY	Passaic	Washington, DC	Somerset
Detroit, MI	Genesee	New York, NY	Ocean	Washington, DC	Fairfax
Detroit, MI	Monroe	New York, NY	Morris	Washington, DC	Kent
Detroit, MI	Lenawee	New York, NY	Richmond	Washington, DC	King George
Dover, DE	Sussex	New York, NY	Mercer	Washington, DC	Madison
Dover, DE	Kent	New York, NY	Rockland	Washington, DC	Falls Churc
Dover, DE	Wicomico	New York, NY	Dutchess	Washington, DC	Manassas Pa
Eugene, OR	Lane	New York, NY	Somerset	Washington, DC	Washington
Eugene, OR	Douglas	New York, NY	Ulster	Washington, DC	Stafford
Evansville, IN	Vanderburgh	New York, NY	Hunterdon	Washington, DC	Berkeley
Evansville, IN	Warrick	New York, NY	Monroe	Washington, DC	Spotsylvani
Evansville, IN	Dubois	New York, NY	Warren	Washington, DC	Fauquier
Evansville, IN	Posey	New York, NY	Putnam	Washington, DC	Jefferson
Evansville, IN	Spencer	New York, NY	Wayne	Washington, DC	Culpeper
Evansville, IN	Pike	New York, NY	Pike	Washington, DC	Warren
Evansville, IN	Henderson	New York, NY	Orange	Washington, DC	Fredericksb
Fort Wayne, IN	Grant	New York, NY	Sussex	Washington, DC	Clarke
Fort Wayne, IN	Huntington	Norfolk, VA	Portsmouth	Waterbury, CT	Litchfield
Fort Wayne, IN	Wabash	Norfolk, VA	Suffolk	Wheeling, WV	Guernsey
Fort Wayne, IN	Allen	Norfolk, VA	York	Wheeling, WV	Belmont
Fort Wayne, IN	De Kalb	Norfolk, VA	Accomack	Wheeling, WV	Ohio
Fort Wayne, IN	Adams	Norfolk, VA	Isle Of Wig	Wheeling, WV	Marshall
Fort Wayne, IN	Whitley	Norfolk, VA	Southampton	York, PA	York
Fort Wayne, IN	Wells	Norfolk, VA	Northampton	Yuba City, CA	Yuba
Fresno, CA	Fresno	Norfolk, VA	Poquoson	Yuba City, CA	Sutter
Fresno, CA	Kings	Norfolk, VA	Northumberl	Benzie Co, MI	Benzie
Fresno, CA	Madera	Norfolk, VA	Mathews	Charlevoix Co, MI	Charlevoix
Fresno, CA	Tuolumne	Norfolk, VA	Surry	Cheboygan Co, MI	Cheboygan
Fresno, CA	Mariposa	Norfolk, VA	Virginia Be	Chippewa Co, MI	Chippewa
Gadsden, AL	Etowah	Norfolk, VA	Norfolk	Emmet Co, MI	Emmet
Gadsden, AL	De Kalb	Norfolk, VA	Newport New	Grand Traverse Co,MI	Grand Trave
Gadsden, AL	Cherokee	Norfolk, VA	Chesapeake	Leelanau Co, MI	Leelanau
Grand Rapids, MI	Kent	Norfolk, VA	Hampton	Mackinac Co, MI	Mackinac
Grand Rapids, MI	Ottawa	Norfolk, VA	James City	Emporia, VA	Emporia
Grand Rapids, MI	Muskegon	Norfolk, VA	Gloucester	Franklin, VA	Franklin
Grand Rapids, MI	Allegan	Norfolk, VA	Currituck		
Grand Rapids, MI	Ionia	Norfolk, VA	Williamsbur		

TABLE A-6
MODELED NONATTAINMENT AREA COUNTIES FOR THE 8H5EX-80 STANDARD UNDER THE LOCAL CONTROL STRATEGY

NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME
Allentown, PA	Lehigh	Dallas, TX	Rockwall	New York, NY	Union
Allentown, PA	Carbon	Dallas, TX	Montague	New York, NY	Ocean
Allentown, PA	Northampton	Dallas, TX	Collin	New York, NY	Morris
Appleton, WI	Manitowoc	Dallas, TX	Johnson	New York, NY	Richmond
Appleton, WI	Outagamie	Dallas, TX	Ellis	New York, NY	Mercer
Appleton, WI	Winnebago	Dallas, TX	Parker	New York, NY	Somerset
Appleton, WI	Calumet	Dallas, TX	Hunt	New York, NY	Hunterdon
Athens, GA	Oconee	Dallas, TX	Henderson	New York, NY	Warren
Athens, GA	Morgan	Dallas, TX	Kaufman	New York, NY	Bronx
Athens, GA	Greene	Dallas, TX	Hood	New York, NY	Bergen
Athens, GA	Clarke	Dover, DE	Sussex	New York, NY	Essex
Athens, GA	Madison	Dover, DE	Kent	New York, NY	Passaic
Atlanta, GA	De Kalb	Evansville, IN	Warrick	New York, NY	Orange
Atlanta, GA	Gwinnett	Evansville, IN	Dubois	New York, NY	Rockland
Atlanta, GA	Clayton	Evansville, IN	Spencer	New York, NY	Dutchess
Atlanta, GA	Floyd	Evansville, IN	Vanderburgh	New York, NY	Sussex
Atlanta, GA	Douglas	Evansville, IN	Henderson	New York, NY	Putnam
Atlanta, GA	Fayette	Evansville, IN	Posey	New York, NY	Pike
Atlanta, GA	Henry	Fresno, CA	Fresno	Owensboro, KY	Hancock
Atlanta, GA	Spalding	Fresno, CA	Mariposa	Owensboro, KY	Daviess
Atlanta, GA	Rockdale	Fresno, CA	Madera	Pensacola, FL	Escambia
Atlanta, GA	Newton	Gadsden, AL	De Kalb	Pensacola, FL	Santa Rosa
Atlanta, GA	Paulding	Gadsden, AL	Cherokee	Philadelphia, PA	Philadelphi
Atlanta, GA	Walton	Gadsden, AL	Etowah	Philadelphia, PA	Montgomery
Atlanta, GA	Polk	Grand Rapids, MI	Ottawa	Philadelphia, PA	Delaware
Atlanta, GA	Barrow	Grand Rapids, MI	Muskegon	Philadelphia, PA	Bucks
Atlanta, GA	Butts	Grand Rapids, MI	Allegan	Philadelphia, PA	Camden
Atlanta, GA	Fulton	Grand Rapids, MI	Kent	Philadelphia, PA	New Castle
Atlanta, GA	Cobb	Greensboro, NC	Guilford	Philadelphia, PA	Burlington
Atlanta, GA	Cherokee	Greensboro, NC	Alamance	Philadelphia, PA	Chester
Atlanta, GA	Carroll	Greensboro, NC	Forsyth	Philadelphia, PA	Gloucester
Atlanta, GA	Bartow	Greensboro, NC	Davidson	Philadelphia, PA	Atlantic
Atlanta, GA	Coweta	Greensboro, NC	Randolph	Philadelphia, PA	Cumberland
Atlanta, GA	Forsyth	Greensboro, NC	Stokes	Philadelphia, PA	Cape May
Atlanta, GA	Pickens	Greensboro, NC	Yadkin	Philadelphia, PA	Salem
Augusta, GA	Barnwell	Greensboro, NC	Davie	Philadelphia, PA	Cecil
Augusta, GA	Taliaferro	Harrisburg, PA	Dauphin	Phoenix, AZ	Maricopa
Augusta, GA	Richmond	Harrisburg, PA	Adams	Phoenix, AZ	Pinal
Augusta, GA	Aiken	Harrisburg, PA	Cumberland	Portland, OR	Clackamas
Augusta, GA	Columbia	Harrisburg, PA	Lebanon	Portland, OR	Marion
Augusta, GA	McDuffie	Harrisburg, PA	Perry	Portland, OR	Linn
Augusta, GA	Edgefield	Hartford, CT	Middlesex	Portland, OR	Multnomah
Bakersfield, CA	Kern	Hartford, CT	Tolland	Portland, OR	Washington
Bangor, ME	Knox	Hartford, CT	Hartford	Portland, OR	Clark
Bangor, ME	Penobscot	Houston, TX	Harris	Portland, OR	Yamhill
Bangor, ME	Waldo	Houston, TX	Fort Bend	Portland, OR	Polk
Baton Rouge, LA	East Baton	Houston, TX	Galveston	Portland, OR	Columbia
Baton Rouge, LA	Iberville	Houston, TX	Brazoria	Providence, RI	Kent

Baton Rouge, LA	West Baton	Houston, TX	Montgomery	Providence, RI	Washington
Baton Rouge, LA	East Felici	Houston, TX	Walker	Providence, RI	Providence
Baton Rouge, LA	Livingston	Houston, TX	Wharton	Providence, RI	Newport
Baton Rouge, LA	Ascension	Houston, TX	Austin	Providence, RI	Bristol
Beaumont, TX	Jefferson	Houston, TX	Liberty	Raleigh, NC	Wake
Beaumont, TX	Orange	Houston, TX	Waller	Raleigh, NC	Durham
Beaumont, TX	Hardin	Houston, TX	Chambers	Raleigh, NC	Orange
Birmingham, AL	Jefferson	Huntington, WV	Lawrence	Raleigh, NC	Johnston
Birmingham, AL	Shelby	Huntington, WV	Boyd	Raleigh, NC	Chatham
Birmingham, AL	St. Clair	Huntington, WV	Martin	Raleigh, NC	Franklin
Birmingham, AL	Blount	Huntington, WV	Cabell	Redding, PA	Berks
Boston, MA	Bristol	Huntington, WV	Wayne	Redding, CA	Shasta
Boston, MA	York	Huntington, WV	Greenup	Redding, CA	Tehama
Boston, MA	Middlesex	Huntington, WV	Carter	Sacramento, CA	Sacramento
Boston, MA	Worcester	Johnson City, TN	Sullivan	Sacramento, CA	Placer
Boston, MA	Essex	Johnson City, TN	Bristol	Sacramento, CA	Yolo
Boston, MA	Suffolk	Johnson City, TN	Washington	Sacramento, CA	El Dorado
Boston, MA	Norfolk	Johnson City, TN	Carter	St Louis, MO	Madison
Boston, MA	Plymouth	Johnson City, TN	Washington	St Louis, MO	St. Louis
Boston, MA	Hillsboroug	Johnson City, TN	Hawkins	St Louis, MO	St. Louis
Boston, MA	Rockingham	Johnson City, TN	Scott	St Louis, MO	St. Clair
Boston, MA	Merrimack	Johnson City, TN	Unicoi	St Louis, MO	St. Charles
Boston, MA	Strafford	Knoxville, TN	Knox	St Louis, MO	Jefferson
Charlotte, NC	Mecklenburg	Knoxville, TN	Anderson	St Louis, MO	Franklin
Charlotte, NC	Rowan	Knoxville, TN	Union	St Louis, MO	Clinton
Charlotte, NC	Cabarrus	Knoxville, TN	Blount	St Louis, MO	Lincoln
Charlotte, NC	Gaston	Knoxville, TN	Sevier	St Louis, MO	Monroe
Charlotte, NC	York	Knoxville, TN	Loudon	St Louis, MO	Jersey
Charlotte, NC	Union	Los Angeles, CA	Los Angeles	St Louis, MO	Warren
Charlotte, NC	Lincoln	Los Angeles, CA	Orange	St Louis, MO	Crawford
Chattanooga, TN	Hamilton	Los Angeles, CA	San Bernard	San Diego, CA	San Diego
Chattanooga, TN	Walker	Los Angeles, CA	Riverside	Santa Barbara, CA	Santa Barba
Chattanooga, TN	Catoosa	Los Angeles, CA	Ventura	Shreveport, LA	Bossier
Chattanooga, TN	Marion	Louisville, KY	Perry	Shreveport, LA	Caddo
Chattanooga, TN	Dade	Louisville, KY	Crawford	Shreveport, LA	Webster
Chicago, IL	Porter	Louisville, KY	Jefferson	Springfield, MA	Hampshire
Chicago, IL	La Porte	Louisville, KY	Clark	Springfield, MA	Hampden
Chicago, IL	Jasper	Louisville, KY	Floyd	Springfield, MA	Franklin
Chicago, IL	Cook	Louisville, KY	Bullitt	State College, PA	Centre
Chicago, IL	Du Page	Louisville, KY	Oldham	Visalia, CA	Tulare
Chicago, IL	Lake	Louisville, KY	Harrison	Washington, DC	Baltimore
Chicago, IL	Lake	Louisville, KY	Scott	Washington, DC	Prince Geor
Chicago, IL	Will	Macon, GA	Baldwin	Washington, DC	Baltimore
Chicago, IL	Kane	Macon, GA	Putnam	Washington, DC	Anne Arunde
Chicago, IL	McHenry	Macon, GA	Bleckley	Washington, DC	Harford
Chicago, IL	Kenosha	Macon, GA	Bibb	Washington, DC	Carroll
Chicago, IL	Kankakee	Macon, GA	Houston	Washington, DC	Talbot
Chicago, IL	De Kalb	Macon, GA	Peach	Washington, DC	Kent
Chicago, IL	Kendall	Macon, GA	Jones	Washington, DC	Fairfax
Chicago, IL	Grundy	Macon, GA	Twiggs	Washington, DC	Montgomery
Cincinnati, OH	Butler	Memphis, TN	Shelby	Washington, DC	Washington
Cincinnati, OH	Warren	Memphis, TN	De Soto	Washington, DC	Prince Will
Cincinnati, OH	Boone	Memphis, TN	Crittenden	Washington, DC	Howard
Cincinnati, OH	Clinton	Memphis, TN	Tipton	Washington, DC	Arlington
Cincinnati, OH	Union	Memphis, TN	Fayette	Washington, DC	Frederick
Cincinnati, OH	Hamilton	Modesto, CA	Stanislaus	Washington, DC	Washington

Cincinnati, OH	Clermont	Nashville, TN	Sumner	Washington, DC	Alexandria
Cincinnati, OH	Kenton	Nashville, TN	Wilson	Washington, DC	Charles
Cincinnati, OH	Campbell	Nashville, TN	Robertson	Washington, DC	Loudoun
Cincinnati, OH	Dearborn	Nashville, TN	Davidson	Washington, DC	Stafford
Cincinnati, OH	Brown	Nashville, TN	Rutherford	Washington, DC	Berkeley
Cincinnati, OH	Grant	Nashville, TN	Williamson	Washington, DC	Spotsylvani
Cincinnati, OH	Pendleton	Nashville, TN	Dickson	Washington, DC	Calvert
Cincinnati, OH	Gallatin	Nashville, TN	Cheatham	Washington, DC	Fauquier
Cincinnati, OH	Ohio	New London, CT	New London	Washington, DC	Jefferson
Columbia, SC	Richland	New London, CT	Windham	Washington, DC	Queen Annes
Columbia, SC	Lexington	New York, NY	Kings	Washington, DC	Manassas
Columbus, OH	Pickaway	New York, NY	Queens	Washington, DC	Culpeper
Columbus, OH	Franklin	New York, NY	New York	Washington, DC	Warren
Columbus, OH	Licking	New York, NY	Suffolk	Washington, DC	Fairfax
Columbus, OH	Fairfield	New York, NY	Nassau	Washington, DC	Fredericksb
Columbus, OH	Delaware	New York, NY	Westchester	Washington, DC	King George
Columbus, OH	Madison	New York, NY	Fairfield	Washington, DC	Clarke
Dallas, TX	Dallas	New York, NY	New Haven	Washington, DC	Falls Churc
Dallas, TX	Tarrant	New York, NY	Middlesex	Washington, DC	Manassas Pa
Dallas, TX	Denton	New York, NY	Monmouth	York, PA	York
Dallas, TX	Wise	New York, NY	Hudson		

TABLE A-7
MODELED NONATTAINMENT AREA COUNTIES
FOR THE 8H4AX-80 STANDARD
UNDER THE LOCAL CONTROL STRATEGY

NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME
Abilene, TX	Callahan	Dallas, TX	Kaufman	New York, NY	Middlesex
Abilene, TX	Taylor	Dallas, TX	Hood	New York, NY	Monmouth
Allentown, PA	Lehigh	Dayton, OH	Clark	New York, NY	Hudson
Allentown, PA	Carbon	Dayton, OH	Greene	New York, NY	Union
Allentown, PA	Northampton	Dayton, OH	Logan	New York, NY	Ocean
Appleton, WI	Manitowoc	Dayton, OH	Montgomery	New York, NY	Morris
Appleton, WI	Outagamie	Dayton, OH	Miami	New York, NY	Richmond
Appleton, WI	Winnebago	Detroit, MI	Macomb	New York, NY	Mercer
Appleton, WI	Calumet	Detroit, MI	Wayne	New York, NY	Somerset
Athens, GA	Oconee	Detroit, MI	Oakland	New York, NY	Hunterdon
Athens, GA	Morgan	Detroit, MI	Genesee	New York, NY	Warren
Athens, GA	Greene	Detroit, MI	Washtenaw	New York, NY	Putnam
Athens, GA	Clarke	Detroit, MI	St. Clair	New York, NY	Bronx
Athens, GA	Madison	Detroit, MI	Monroe	New York, NY	Essex
Atlanta, GA	Fulton	Detroit, MI	Livingston	New York, NY	Passaic
Atlanta, GA	De Kalb	Detroit, MI	Lenawee	New York, NY	Orange
Atlanta, GA	Gwinnett	Detroit, MI	Lapeer	New York, NY	Rockland
Atlanta, GA	Clayton	Dover, DE	Sussex	New York, NY	Dutchess
Atlanta, GA	Floyd	Dover, DE	Kent	New York, NY	Sussex
Atlanta, GA	Douglas	Evansville, IN	Warrick	New York, NY	Pike
Atlanta, GA	Fayette	Evansville, IN	Dubois	Owensboro, KY	Hancock
Atlanta, GA	Henry	Evansville, IN	Spencer	Owensboro, KY	Daviess
Atlanta, GA	Spalding	Evansville, IN	Vanderburgh	Pensacola, FL	Escambia
Atlanta, GA	Rockdale	Evansville, IN	Henderson	Pensacola, FL	Santa Rosa
Atlanta, GA	Newton	Evansville, IN	Posey	Philadelphia, PA	Philadelphi
Atlanta, GA	Paulding	Fresno, CA	Fresno	Philadelphia, PA	Montgomery
Atlanta, GA	Walton	Fresno, CA	Mariposa	Philadelphia, PA	Delaware
Atlanta, GA	Polk	Fresno, CA	Madera	Philadelphia, PA	Bucks
Atlanta, GA	Barrow	Gadsden, AL	De Kalb	Philadelphia, PA	Camden
Atlanta, GA	Butts	Gadsden, AL	Cherokee	Philadelphia, PA	New Castle
Atlanta, GA	Cobb	Gadsden, AL	Etowah	Philadelphia, PA	Burlington
Atlanta, GA	Cherokee	Grand Rapids, MI	Kent	Philadelphia, PA	Chester
Atlanta, GA	Carroll	Grand Rapids, MI	Ottawa	Philadelphia, PA	Gloucester
Atlanta, GA	Bartow	Grand Rapids, MI	Muskegon	Philadelphia, PA	Atlantic
Atlanta, GA	Coweta	Grand Rapids, MI	Allegan	Philadelphia, PA	Cumberland
Atlanta, GA	Forsyth	Greensboro, NC	Guilford	Philadelphia, PA	Cape May
Atlanta, GA	Pickens	Greensboro, NC	Alamance	Philadelphia, PA	Salem
Augusta, GA	Aiken	Greensboro, NC	Forsyth	Philadelphia, PA	Cecil
Augusta, GA	Barnwell	Greensboro, NC	Davidson	Phoenix, AZ	Maricopa
Augusta, GA	Washington	Greensboro, NC	Randolph	Phoenix, AZ	Pinal
Augusta, GA	Bamberg	Greensboro, NC	Stokes	Pittsfield, MA	Berkshire
Augusta, GA	Taliaferro	Greensboro, NC	Yadkin	Portland, OR	Clackamas
Augusta, GA	Richmond	Greensboro, NC	Davie	Portland, OR	Marion
Augusta, GA	Columbia	Harrisburg, PA	Dauphin	Portland, OR	Linn
Augusta, GA	McDuffie	Harrisburg, PA	Adams	Portland, OR	Multnomah
Augusta, GA	Edgefield	Harrisburg, PA	Cumberland	Portland, OR	Washington
Bakersfield, CA	Kern	Harrisburg, PA	Lebanon	Portland, OR	Clark
Bangor, ME	Hancock	Harrisburg, PA	Perry	Portland, OR	Yamhill

Bangor, ME	Knox	Hartford, CT	Hartford	Portland, OR	Polk
Bangor, ME	Penobscot	Hartford, CT	Middlesex	Portland, OR	Columbia
Bangor, ME	Waldo	Hartford, CT	Tolland	Providence, RI	Kent
Barnstable, MA	Barnstable	Houston, TX	Harris	Providence, RI	Washington
Baton Rouge, LA	East Baton	Houston, TX	Fort Bend	Providence, RI	Providence
Baton Rouge, LA	Iberville	Houston, TX	Galveston	Providence, RI	Newport
Baton Rouge, LA	West Baton	Houston, TX	Brazoria	Providence, RI	Bristol
Baton Rouge, LA	East Felici	Houston, TX	Montgomery	Raleigh, NC	Wake
Baton Rouge, LA	Livingston	Houston, TX	Walker	Raleigh, NC	Durham
Baton Rouge, LA	Ascension	Houston, TX	Wharton	Raleigh, NC	Orange
Beaumont, TX	Jefferson	Houston, TX	Austin	Raleigh, NC	Johnston
Beaumont, TX	Orange	Houston, TX	Liberty	Raleigh, NC	Chatham
Beaumont, TX	Hardin	Houston, TX	Waller	Raleigh, NC	Franklin
Birmingham, AL	Jefferson	Houston, TX	Chambers	Redding, PA	Berks
Birmingham, AL	Shelby	Huntington, WV	Lawrence	Redding, CA	Shasta
Birmingham, AL	St. Clair	Huntington, WV	Boyd	Redding, CA	Tehama
Birmingham, AL	Blount	Huntington, WV	Martin	Sacramento, CA	Sacramento
Boston, MA	Bristol	Huntington, WV	Cabell	Sacramento, CA	Placer
Boston, MA	York	Huntington, WV	Wayne	Sacramento, CA	Yolo
Boston, MA	Middlesex	Huntington, WV	Greenup	Sacramento, CA	El Dorado
Boston, MA	Worcester	Huntington, WV	Carter	St Louis, MO	St. Louis
Boston, MA	Essex	Johnson City, TN	Sullivan	St Louis, MO	Madison
Boston, MA	Suffolk	Johnson City, TN	Washington	St Louis, MO	Macoupin
Boston, MA	Norfolk	Johnson City, TN	Bristol	St Louis, MO	St. Louis
Boston, MA	Plymouth	Johnson City, TN	Washington	St Louis, MO	St. Clair
Boston, MA	Hillsboroug	Johnson City, TN	Carter	St Louis, MO	St. Charles
Boston, MA	Rockingham	Johnson City, TN	Hawkins	St Louis, MO	Jefferson
Boston, MA	Merrimack	Johnson City, TN	Scott	St Louis, MO	Franklin
Boston, MA	Strafford	Johnson City, TN	Unicoi	St Louis, MO	Clinton
Charlotte, NC	Mecklenburg	Knoxville, TN	Knox	St Louis, MO	Lincoln
Charlotte, NC	Rowan	Knoxville, TN	Anderson	St Louis, MO	Monroe
Charlotte, NC	Cabarrus	Knoxville, TN	Union	St Louis, MO	Jersey
Charlotte, NC	Chester	Knoxville, TN	Blount	St Louis, MO	Warren
Charlotte, NC	Gaston	Knoxville, TN	Sevier	St Louis, MO	Crawford
Charlotte, NC	York	Knoxville, TN	Loudon	San Diego, CA	San Diego
Charlotte, NC	Union	Los Angeles, CA	Los Angeles	Santa Barbara, CA	Santa Barba
Charlotte, NC	Lincoln	Los Angeles, CA	Orange	Scranton, PA	Luzerne
Chattanooga, TN	Hamilton	Los Angeles, CA	San Bernard	Scranton, PA	Lackawanna
Chattanooga, TN	Whitfield	Los Angeles, CA	Riverside	Scranton, PA	Columbia
Chattanooga, TN	Walker	Los Angeles, CA	Ventura	Scranton, PA	Wyoming
Chattanooga, TN	Catoosa	Louisville, KY	Clark	Seattle, WA	King
Chattanooga, TN	Chattooga	Louisville, KY	Perry	Seattle, WA	Pierce
Chattanooga, TN	Marion	Louisville, KY	Crawford	Seattle, WA	Snohomish
Chattanooga, TN	Dade	Louisville, KY	Jefferson	Seattle, WA	Kitsap
Chicago, IL	Porter	Louisville, KY	Floyd	Seattle, WA	Thurston
Chicago, IL	Kenosha	Louisville, KY	Bullitt	Seattle, WA	Island
Chicago, IL	La Porte	Louisville, KY	Oldham	Sharon, PA	Mercer
Chicago, IL	Jasper	Louisville, KY	Harrison	Shreveport, LA	Bossier
Chicago, IL	Cook	Louisville, KY	Scott	Shreveport, LA	Caddo
Chicago, IL	Du Page	Macon, GA	Baldwin	Shreveport, LA	Webster
Chicago, IL	Lake	Macon, GA	Putnam	Springfield, MA	Hampden
Chicago, IL	Lake	Macon, GA	Bleckley	Springfield, MA	Hampshire
Chicago, IL	Will	Macon, GA	Wilkinson	Springfield, MA	Franklin
Chicago, IL	Kane	Macon, GA	Bibb	State College, PA	Centre
Chicago, IL	McHenry	Macon, GA	Houston	Tulsa, OK	Tulsa
Chicago, IL	Kankakee	Macon, GA	Peach	Tulsa, OK	Creek

Chicago, IL	De Kalb	Macon, GA	Jones	Tulsa, OK	Rogers
Chicago, IL	Kendall	Macon, GA	Twiggs	Tulsa, OK	Wagoner
Chicago, IL	Grundy	Memphis, TN	Shelby	Tulsa, OK	Osage
Cincinnati, OH	Hamilton	Memphis, TN	De Soto	Visalia, CA	Tulare
Cincinnati, OH	Butler	Memphis, TN	Crittenden	Washington, DC	Fairfax
Cincinnati, OH	Warren	Memphis, TN	Tipton	Washington, DC	Baltimore
Cincinnati, OH	Boone	Memphis, TN	Fayette	Washington, DC	Prince Geor
Cincinnati, OH	Clinton	Milwaukee, WI	Milwaukee	Washington, DC	Baltimore
Cincinnati, OH	Union	Milwaukee, WI	Waukesha	Washington, DC	Anne Arunde
Cincinnati, OH	Clermont	Milwaukee, WI	Racine	Washington, DC	Harford
Cincinnati, OH	Kenton	Milwaukee, WI	Washington	Washington, DC	Carroll
Cincinnati, OH	Campbell	Milwaukee, WI	Ozaukee	Washington, DC	Queen Annes
Cincinnati, OH	Dearborn	Modesto, CA	Stanislaus	Washington, DC	Talbot
Cincinnati, OH	Brown	Nashville, TN	Sumner	Washington, DC	Fairfax
Cincinnati, OH	Grant	Nashville, TN	Wilson	Washington, DC	Kent
Cincinnati, OH	Pendleton	Nashville, TN	Robertson	Washington, DC	Montgomery
Cincinnati, OH	Gallatin	Nashville, TN	Davidson	Washington, DC	Washington
Cincinnati, OH	Ohio	Nashville, TN	Rutherford	Washington, DC	Prince Will
Columbia, SC	Richland	Nashville, TN	Williamson	Washington, DC	Howard
Columbia, SC	Lexington	Nashville, TN	Dickson	Washington, DC	Arlington
Columbus, OH	Ross	Nashville, TN	Cheatham	Washington, DC	Frederick
Columbus, OH	Pickaway	New London, CT	New London	Washington, DC	Washington
Columbus, OH	Franklin	New London, CT	Windham	Washington, DC	Alexandria
Columbus, OH	Licking	New Orleans, LA	St. Tammany	Washington, DC	Charles
Columbus, OH	Fairfield	New Orleans, LA	Orleans	Washington, DC	Loudoun
Columbus, OH	Delaware	New Orleans, LA	Jefferson	Washington, DC	Stafford
Columbus, OH	Madison	New Orleans, LA	St. Bernard	Washington, DC	Berkeley
Dallas, TX	Dallas	New Orleans, LA	St. Charles	Washington, DC	Spotsylvani
Dallas, TX	Tarrant	New Orleans, LA	St. John Th	Washington, DC	Calvert
Dallas, TX	Denton	New Orleans, LA	Plaquemines	Washington, DC	Fauquier
Dallas, TX	Wise	New Orleans, LA	St. James	Washington, DC	Jefferson
Dallas, TX	Rockwall	New York, NY	Kings	Washington, DC	Manassas
Dallas, TX	Palo Pinto	New York, NY	Queens	Washington, DC	Culpeper
Dallas, TX	Montague	New York, NY	New York	Washington, DC	Warren
Dallas, TX	Collin	New York, NY	Suffolk	Washington, DC	Fredericksb
Dallas, TX	Johnson	New York, NY	Nassau	Washington, DC	King George
Dallas, TX	Ellis	New York, NY	Westchester	Washington, DC	Clarke
Dallas, TX	Parker	New York, NY	Fairfield	Washington, DC	Falls Churc
Dallas, TX	Hunt	New York, NY	Bergen	Washington, DC	Manassas Pa
Dallas, TX	Henderson	New York, NY	New Haven	York, PA	York

TABLE A-8
MODELED NONATTAINMENT AREA COUNTIES FOR THE 8H1AX-80 STANDARD UNDER THE LOCAL CONTROL STRATEGY

NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME	NONATTAINMENT AREA	COUNTY NAME
Atlanta, GA	Fulton	Greensboro, NC	Patrick	Orlando, FL	Lake
Atlanta, GA	Gilmer	Greensboro, NC	Randolph	Orlando, FL	Orange
Atlanta, GA	Gordon	Greensboro, NC	Rockingham	Orlando, FL	Osceola
Atlanta, GA	Gwinnett	Greensboro, NC	Stokes	Orlando, FL	Seminole
Atlanta, GA	Haralson	Greensboro, NC	Surry	Owensboro, KY	Daviess
Atlanta, GA	Henry	Greensboro, NC	Yadkin	Owensboro, KY	Hancock
Atlanta, GA	Jackson	Greenville, SC	Anderson	Parkersburg, WV	Athens
Atlanta, GA	Meriwether	Greenville, SC	Cherokee	Parkersburg, WV	Gilmer
Atlanta, GA	Morgan	Greenville, SC	Greenville	Parkersburg, WV	Jackson
Atlanta, GA	Newton	Greenville, SC	Pickens	Parkersburg, WV	Meigs
Atlanta, GA	Paulding	Greenville, SC	Spartanburg	Parkersburg, WV	Morgan
Atlanta, GA	Pickens	Harrisburg, PA	Cumberland	Parkersburg, WV	Noble
Atlanta, GA	Pike	Harrisburg, PA	Dauphin	Parkersburg, WV	Washington
Atlanta, GA	Polk	Harrisburg, PA	Lebanon	Parkersburg, WV	Wirt
Atlanta, GA	Rockdale	Harrisburg, PA	Perry	Parkersburg, WV	Wood
Atlanta, GA	Spalding	Hartford, CT	Hartford	Pensacola, FL	Escambia
Atlanta, GA	Walton	Hartford, CT	Middlesex	Pensacola, FL	Santa Rosa
Augusta, GA	Aiken	Hartford, CT	Tolland	Philadelphia, PA	Atlantic
Augusta, GA	Allendale	Hickory, NC	Alexander	Philadelphia, PA	Bucks
Augusta, GA	Bamberg	Hickory, NC	Burke	Philadelphia, PA	Burlington
Augusta, GA	Barnwell	Hickory, NC	Caldwell	Philadelphia, PA	Camden
Augusta, GA	Columbia	Hickory, NC	Catawba	Philadelphia, PA	Cape May
Augusta, GA	Edgefield	Hickory, NC	Wilkes	Philadelphia, PA	Cecil
Augusta, GA	Glascock	Houston, TX	Austin	Philadelphia, PA	Chester
Augusta, GA	McDuffie	Houston, TX	Brazoria	Philadelphia, PA	Cumberland
Augusta, GA	Richmond	Houston, TX	Chambers	Philadelphia, PA	Delaware
Augusta, GA	Taliaferro	Houston, TX	Fort Bend	Philadelphia, PA	Gloucester
Augusta, GA	Washington	Houston, TX	Galveston	Philadelphia, PA	Montgomery
Austin, TX	Bastrop	Houston, TX	Harris	Philadelphia, PA	New Castle
Austin, TX	Burnet	Houston, TX	Liberty	Philadelphia, PA	Philadelphi
Austin, TX	Caldwell	Houston, TX	Matagorda	Philadelphia, PA	Salem
Austin, TX	Hays	Houston, TX	Montgomery	Phoenix, AZ	Maricopa
Austin, TX	Travis	Houston, TX	Polk	Phoenix, AZ	Pinal
Austin, TX	Williamson	Houston, TX	Trinity	Pittsburgh, PA	Allegheny
Bakersfield, CA	Kern	Houston, TX	Walker	Pittsburgh, PA	Armstrong
Bangor, ME	Hancock	Houston, TX	Waller	Pittsburgh, PA	Beaver
Bangor, ME	Kennebec	Houston, TX	Wharton	Pittsburgh, PA	Butler
Bangor, ME	Knox	Huntington, WV	Boyd	Pittsburgh, PA	Clarion
Bangor, ME	Lincoln	Huntington, WV	Cabell	Pittsburgh, PA	Fayette
Bangor, ME	Penobscot	Huntington, WV	Carter	Pittsburgh, PA	Forest
Bangor, ME	Waldo	Huntington, WV	Gallia	Pittsburgh, PA	Tucker
Barnstable, MA	Barnstable	Huntington, WV	Greenup	Pittsburgh, PA	Washington
Barnstable, MA	Nantucket	Huntington, WV	Jackson	Pittsburgh, PA	Westmorelan
Baton Rouge, LA	Ascension	Huntington, WV	Johnson	Pittsfield, MA	Berkshire
Baton Rouge, LA	East Baton	Huntington, WV	Lawrence	Portland, ME	Cumberland
Baton Rouge, LA	East Felici	Huntington, WV	Lawrence	Portland, OR	Benton
Baton Rouge, LA	Iberville	Huntington, WV	Martin	Portland, OR	Clackamas
Baton Rouge, LA	Livingston	Huntington, WV	Pike	Portland, OR	Clark

Baton Rouge, LA	Pointe Coup	Huntington, WV	Scioto	Portland, OR	Columbia
Baton Rouge, LA	West Baton	Huntington, WV	Wayne	Portland, OR	Jefferson
Beaumont, TX	Hardin	Indianapolis, IN	Bartholomew	Portland, OR	Lincoln
Beaumont, TX	Jefferson	Indianapolis, IN	Boone	Portland, OR	Linn
Beaumont, TX	Orange	Indianapolis, IN	Decatur	Portland, OR	Marion
Benzie Co, MI	Benzie	Indianapolis, IN	Hamilton	Portland, OR	Multnomah
Biloxi, MS	Hancock	Indianapolis, IN	Hancock	Portland, OR	Polk
Biloxi, MS	Harrison	Indianapolis, IN	Hendricks	Portland, OR	Washington
Biloxi, MS	Jackson	Indianapolis, IN	Johnson	Portland, OR	Yamhill
Birmingham, AL	Blount	Indianapolis, IN	Madison	Providence, RI	Bristol
Birmingham, AL	Jefferson	Indianapolis, IN	Marion	Providence, RI	Kent
Birmingham, AL	Shelby	Indianapolis, IN	Morgan	Providence, RI	Newport
Birmingham, AL	St. Clair	Indianapolis, IN	Rush	Providence, RI	Providence
Bloomington, IN	Lawrence	Indianapolis, IN	Shelby	Providence, RI	Washington
Bloomington, IN	Martin	Johnson City, TN	Avery	Raleigh, NC	Chatham
Bloomington, IN	Monroe	Johnson City, TN	Bristol	Raleigh, NC	Durham
Boston, MA	Bristol	Johnson City, TN	Carter	Raleigh, NC	Franklin
Boston, MA	Essex	Johnson City, TN	Dickenson	Raleigh, NC	Granville
Boston, MA	Hillsboroug	Johnson City, TN	Hawkins	Raleigh, NC	Harnett
Boston, MA	Merrimack	Johnson City, TN	Mitchell	Raleigh, NC	Johnston
Boston, MA	Middlesex	Johnson City, TN	Russell	Raleigh, NC	Orange
Boston, MA	Norfolk	Johnson City, TN	Scott	Raleigh, NC	Person
Boston, MA	Plymouth	Johnson City, TN	Smyth	Raleigh, NC	Wake
Boston, MA	Rockingham	Johnson City, TN	Sullivan	Redding, CA	Shasta
Boston, MA	Strafford	Johnson City, TN	Tazewell	Redding, CA	Tehama
Boston, MA	Suffolk	Johnson City, TN	Unicoi	Redding, PA	Berks
Boston, MA	Worcester	Johnson City, TN	Washington	Reno, NV	Washoe
Boston, MA	York	Johnson City, TN	Washington	Richmond, VA	Charles Cit
Buffalo, NY	Erie	Johnstown, PA	Cambria	Richmond, VA	Chesterfiel
Buffalo, NY	Niagara	Johnstown, PA	Jefferson	Richmond, VA	Colonial He
Canton, OH	Carroll	Johnstown, PA	Somerset	Richmond, VA	Dinwiddie
Canton, OH	Stark	Joplin, MO	Jasper	Richmond, VA	Goochland
Champaign, IL	Champaign	Joplin, MO	Neosho	Richmond, VA	Greensville
Charleston, WV	Kanawha	Joplin, MO	Newton	Richmond, VA	Hanover
Charleston, WV	Mason	Knoxville, TN	Anderson	Richmond, VA	Henrico
Charleston, WV	Putnam	Knoxville, TN	Bell	Richmond, VA	Hopewell
Charleston, WV	Roane	Knoxville, TN	Blount	Richmond, VA	New Kent
Charlevoix Co, MI	Charlevoix	Knoxville, TN	Campbell	Richmond, VA	Petersburg
Charlotte, NC	Cabarrus	Knoxville, TN	Claiborne	Richmond, VA	Powhatan
Charlotte, NC	Chester	Knoxville, TN	Cumberland	Richmond, VA	Prince Edwa
Charlotte, NC	Gaston	Knoxville, TN	Grainger	Richmond, VA	Prince Geor
Charlotte, NC	Lincoln	Knoxville, TN	Jefferson	Richmond, VA	Richmond
Charlotte, NC	Mecklenburg	Knoxville, TN	Knox	Richmond, VA	Sussex
Charlotte, NC	Rowan	Knoxville, TN	Loudon	Rochester, NY	Genesee
Charlotte, NC	Stanly	Knoxville, TN	McCreary	Rochester, NY	Livingston
Charlotte, NC	Union	Knoxville, TN	Scott	Rochester, NY	Monroe
Charlotte, NC	York	Knoxville, TN	Sevier	Rochester, NY	Ontario
Chattanooga, TN	Bradley	Knoxville, TN	Union	Rochester, NY	Orleans
Chattanooga, TN	Catoosa	Knoxville, TN	Whitley	Rochester, NY	Wayne
Chattanooga, TN	Chattooga	Kokomo, IN	Howard	Rochester, NY	Wyoming
Chattanooga, TN	Dade	Kokomo, IN	Tipton	Rochester, NY	Yates
Chattanooga, TN	Hamilton	Lafayette, IN	Clinton	Rocky Mount, NC	Edgecombe
Chattanooga, TN	Marion	Lafayette, IN	Tippecanoe	Rocky Mount, NC	Nash
Chattanooga, TN	Murray	Lancaster, PA	Lancaster	Rocky Mount, NC	Northampton
Chattanooga, TN	Walker	Lawton, OK	Comanche	Sacramento, CA	El Dorado
Chattanooga, TN	Whitfield	Lawton, OK	Greer	Sacramento, CA	Nevada

Cheboygan Co, MI	Cheboygan	Leelanau Co, MI	Leelanau	Sacramento, CA	Placer
Chicago, IL	Cook	Lewiston, ME	Androscoggi	Sacramento, CA	Sacramento
Chicago, IL	De Kalb	Lewiston, ME	Sagadahoc	Sacramento, CA	Yolo
Chicago, IL	Du Page	Lexington, KY	Anderson	Salinas, CA	Monterey
Chicago, IL	Grundy	Lexington, KY	Bourbon	Salinas, CA	San Benito
Chicago, IL	Jasper	Lexington, KY	Boyle	San Diego, CA	San Diego
Chicago, IL	Kane	Lexington, KY	Clark	San Francisco, CA	Alameda
Chicago, IL	Kankakee	Lexington, KY	Fayette	San Francisco, CA	Contra Cost
Chicago, IL	Kendall	Lexington, KY	Franklin	San Francisco, CA	Marin
Chicago, IL	Kenosha	Lexington, KY	Garrard	San Francisco, CA	Napa
Chicago, IL	La Porte	Lexington, KY	Jessamine	San Francisco, CA	San Francis
Chicago, IL	Lake	Lexington, KY	Lincoln	San Francisco, CA	San Mateo
Chicago, IL	Lake	Lexington, KY	Madison	San Francisco, CA	Santa Clara
Chicago, IL	McHenry	Lexington, KY	Mercer	San Francisco, CA	Santa Cruz
Chicago, IL	Porter	Lexington, KY	Pulaski	San Francisco, CA	Solano
Chicago, IL	Will	Lexington, KY	Scott	San Francisco, CA	Sonoma
Chippewa Co, MI	Chippewa	Lexington, KY	Woodford	Santa Barbara, CA	Santa Barba
Cincinnati, OH	Boone	Lima, OH	Allen	Savannah, GA	Appling
Cincinnati, OH	Brown	Lima, OH	Auglaize	Savannah, GA	Bryan
Cincinnati, OH	Butler	Lima, OH	Logan	Savannah, GA	Chatham
Cincinnati, OH	Campbell	Longview, TX	Franklin	Savannah, GA	Effingham
Cincinnati, OH	Carroll	Longview, TX	Gregg	Savannah, GA	Jeff Davis
Cincinnati, OH	Clermont	Longview, TX	Harrison	Savannah, GA	Toombs
Cincinnati, OH	Clinton	Longview, TX	Titus	Scranton, PA	Columbia
Cincinnati, OH	Dearborn	Longview, TX	Upshur	Scranton, PA	Lackawanna
Cincinnati, OH	Franklin	Los Angeles, CA	Los Angeles	Scranton, PA	Luzerne
Cincinnati, OH	Gallatin	Los Angeles, CA	Orange	Scranton, PA	Schuylkill
Cincinnati, OH	Grant	Los Angeles, CA	Riverside	Scranton, PA	Susquehanna
Cincinnati, OH	Hamilton	Los Angeles, CA	San Bernard	Scranton, PA	Wyoming
Cincinnati, OH	Highland	Los Angeles, CA	Ventura	Seattle, WA	Douglas
Cincinnati, OH	Kenton	Louisville, KY	Breckinridg	Seattle, WA	Island
Cincinnati, OH	Ohio	Louisville, KY	Bullitt	Seattle, WA	King
Cincinnati, OH	Pendleton	Louisville, KY	Clark	Seattle, WA	Kitsap
Cincinnati, OH	Ripley	Louisville, KY	Crawford	Seattle, WA	Lewis
Cincinnati, OH	Switzerland	Louisville, KY	Floyd	Seattle, WA	Pierce
Cincinnati, OH	Union	Louisville, KY	Harrison	Seattle, WA	Snohomish
Cincinnati, OH	Warren	Louisville, KY	Jackson	Seattle, WA	Thurston
Cleveland, OH	Ashtabula	Louisville, KY	Jefferson	Sharon, PA	Mercer
Cleveland, OH	Crawford	Louisville, KY	Jennings	Sharon, PA	Venango
Cleveland, OH	Cuyahoga	Louisville, KY	Meade	Sheboygan, WI	Sheboygan
Cleveland, OH	Geauga	Louisville, KY	Oldham	Sherman, TX	Grayson
Cleveland, OH	Lake	Louisville, KY	Orange	Sherman, TX	Johnston
Cleveland, OH	Lorain	Louisville, KY	Perry	Sherman, TX	Love
Cleveland, OH	Medina	Louisville, KY	Scott	Sherman, TX	Marshall
Cleveland, OH	Portage	Louisville, KY	Trimble	Shreveport, LA	Bossier
Cleveland, OH	Summit	Louisville, KY	Washington	Shreveport, LA	Caddo
Columbia, SC	Calhoun	Mackinac Co, MI	Mackinac	Shreveport, LA	De Soto
Columbia, SC	Fairfield	Macon, GA	Baldwin	Shreveport, LA	Red River
Columbia, SC	Lexington	Macon, GA	Bibb	Shreveport, LA	Webster
Columbia, SC	Richland	Macon, GA	Bleckley	Springfield, MA	Franklin
Columbus, GA	Chattahooch	Macon, GA	Houston	Springfield, MA	Hampden
Columbus, GA	Harris	Macon, GA	Johnson	Springfield, MA	Hampshire
Columbus, GA	Marion	Macon, GA	Jones	St Louis, MO	Bond
Columbus, GA	Muscogee	Macon, GA	Laurens	St Louis, MO	Clinton
Columbus, GA	Russell	Macon, GA	Montgomery	St Louis, MO	Crawford
Columbus, OH	Delaware	Macon, GA	Peach	St Louis, MO	Franklin

Columbus, OH	Fairfield	Macon, GA	Putnam	St Louis, MO	Greene
Columbus, OH	Fayette	Macon, GA	Treutlen	St Louis, MO	Jefferson
Columbus, OH	Franklin	Macon, GA	Twiggs	St Louis, MO	Jersey
Columbus, OH	Knox	Macon, GA	Wheeler	St Louis, MO	Lincoln
Columbus, OH	Licking	Macon, GA	Wilkinson	St Louis, MO	Macoupin
Columbus, OH	Madison	Memphis, TN	Crittenden	St Louis, MO	Madison
Columbus, OH	Muskingum	Memphis, TN	De Soto	St Louis, MO	Monroe
Columbus, OH	Pickaway	Memphis, TN	Fayette	St Louis, MO	St. Charles
Columbus, OH	Ross	Memphis, TN	Shelby	St Louis, MO	St. Clair
Columbus, OH	Union	Memphis, TN	Tate	St Louis, MO	St. Louis
Columbus, OH	Vinton	Memphis, TN	Tipton	St Louis, MO	St. Louis
Dallas, TX	Collin	Milwaukee, WI	Milwaukee	St Louis, MO	Warren
Dallas, TX	Cooke	Milwaukee, WI	Ozaukee	St Louis, MO	Washington
Dallas, TX	Dallas	Milwaukee, WI	Racine	State College, PA	Centre
Dallas, TX	Delta	Milwaukee, WI	Washington	State College, PA	Clearfield
Dallas, TX	Denton	Milwaukee, WI	Waukesha	State College, PA	Elk
Dallas, TX	Eastland	Mobile, AL	Baldwin	Stockton, CA	San Joaquin
Dallas, TX	Ellis	Mobile, AL	Mobile	Syracuse, NY	Cayuga
Dallas, TX	Henderson	Modesto, CA	Stanislaus	Syracuse, NY	Madison
Dallas, TX	Hood	Muncie, IN	Blackford	Syracuse, NY	Onondaga
Dallas, TX	Hopkins	Muncie, IN	Delaware	Syracuse, NY	Oswego
Dallas, TX	Houston	Nashville, TN	Barren	Syracuse, NY	Seneca
Dallas, TX	Hunt	Nashville, TN	Cannon	Tampa, FL	Hernando
Dallas, TX	Johnson	Nashville, TN	Cheatham	Tampa, FL	Hillsboroug
Dallas, TX	Kaufman	Nashville, TN	Davidson	Tampa, FL	Pasco
Dallas, TX	Lamar	Nashville, TN	Dickson	Tampa, FL	Pinellas
Dallas, TX	Montague	Nashville, TN	Logan	Terre Haute, IN	Clay
Dallas, TX	Palo Pinto	Nashville, TN	Macon	Terre Haute, IN	Owen
Dallas, TX	Parker	Nashville, TN	Maury	Terre Haute, IN	Vermillion
Dallas, TX	Rockwall	Nashville, TN	Robertson	Terre Haute, IN	Vigo
Dallas, TX	Tarrant	Nashville, TN	Rutherford	Texarkana, AR	Bowie
Dallas, TX	Wise	Nashville, TN	Simpson	Texarkana, AR	Miller
Dayton, OH	Champaign	Nashville, TN	Sumner	Texarkana, AR	Red River
Dayton, OH	Clark	Nashville, TN	Williamson	Tulsa, OK	Chautauqua
Dayton, OH	Greene	Nashville, TN	Wilson	Tulsa, OK	Creek
Dayton, OH	Miami	New London, CT	New London	Tulsa, OK	Labette
Dayton, OH	Montgomery	New London, CT	Windham	Tulsa, OK	Montgomery
Dayton, OH	Preble	New Orleans, LA	Jefferson	Tulsa, OK	Osage
Detroit, MI	Genesee	New Orleans, LA	Orleans	Tulsa, OK	Pawnee
Detroit, MI	Lapeer	New Orleans, LA	Plaquemines	Tulsa, OK	Rogers
Detroit, MI	Lenawee	New Orleans, LA	St. Bernard	Tulsa, OK	Tulsa
Detroit, MI	Livingston	New Orleans, LA	St. Charles	Tulsa, OK	Wagoner
Detroit, MI	Macomb	New Orleans, LA	St. James	Tulsa, OK	Washington
Detroit, MI	Monroe	New Orleans, LA	St. John Th	Utica, NY	Herkimer
Detroit, MI	Oakland	New Orleans, LA	St. Tammany	Utica, NY	Oneida
Detroit, MI	St. Clair	New York, NY	Bergen	Visalia, CA	Tulare
Detroit, MI	Washtenaw	New York, NY	Bronx	Washington, DC	Adams
Detroit, MI	Wayne	New York, NY	Dutchess	Washington, DC	Alexandria
Dover, DE	Kent	New York, NY	Essex	Washington, DC	Anne Arunde
Dover, DE	Sussex	New York, NY	Fairfield	Washington, DC	Arlington
Dover, DE	Wicomico	New York, NY	Hudson	Washington, DC	Baltimore
Emmet Co, MI	Emmet	New York, NY	Hunterdon	Washington, DC	Baltimore
Emporia, VA	Emporia	New York, NY	Kings	Washington, DC	Berkeley
Eugene, OR	Douglas	New York, NY	Mercer	Washington, DC	Calvert
Eugene, OR	Lane	New York, NY	Middlesex	Washington, DC	Caroline
Evansville, IN	Dubois	New York, NY	Monmouth	Washington, DC	Carroll

Evansville, IN	Henderson	New York, NY	Monroe	Washington, DC	Charles
Evansville, IN	Pike	New York, NY	Morris	Washington, DC	Clarke
Evansville, IN	Posey	New York, NY	Nassau	Washington, DC	Culpeper
Evansville, IN	Spencer	New York, NY	New Haven	Washington, DC	Dorchester
Evansville, IN	Vanderburgh	New York, NY	New York	Washington, DC	Fairfax
Evansville, IN	Warrick	New York, NY	Ocean	Washington, DC	Fairfax
Fort Wayne, IN	Adams	New York, NY	Orange	Washington, DC	Falls Churc
Fort Wayne, IN	Allen	New York, NY	Passaic	Washington, DC	Fauquier
Fort Wayne, IN	De Kalb	New York, NY	Pike	Washington, DC	Franklin
Fort Wayne, IN	Grant	New York, NY	Putnam	Washington, DC	Frederick
Fort Wayne, IN	Huntington	New York, NY	Queens	Washington, DC	Fredericksb
Fort Wayne, IN	Wabash	New York, NY	Richmond	Washington, DC	Harford
Fort Wayne, IN	Wells	New York, NY	Rockland	Washington, DC	Howard
Fort Wayne, IN	Whitley	New York, NY	Somerset	Washington, DC	Jefferson
Franklin, VA	Franklin	New York, NY	Suffolk	Washington, DC	Kent
Fresno, CA	Fresno	New York, NY	Sussex	Washington, DC	King George
Fresno, CA	Kings	New York, NY	Ulster	Washington, DC	Loudoun
Fresno, CA	Madera	New York, NY	Union	Washington, DC	Madison
Fresno, CA	Mariposa	New York, NY	Warren	Washington, DC	Manassas
Fresno, CA	Tuolumne	New York, NY	Wayne	Washington, DC	Manassas Pa
Gadsden, AL	Cherokee	New York, NY	Westchester	Washington, DC	Montgomery
Gadsden, AL	De Kalb	Norfolk, VA	Accomack	Washington, DC	Prince Geor
Gadsden, AL	Etowah	Norfolk, VA	Chesapeake	Washington, DC	Prince Will
Grand Rapids, MI	Allegan	Norfolk, VA	Currituck	Washington, DC	Queen Annes
Grand Rapids, MI	Barry	Norfolk, VA	Gloucester	Washington, DC	Somerset
Grand Rapids, MI	Ionia	Norfolk, VA	Hampton	Washington, DC	Spotsylvani
Grand Rapids, MI	Kent	Norfolk, VA	Isle Of Wig	Washington, DC	Stafford
Grand Rapids, MI	Manistee	Norfolk, VA	James City	Washington, DC	Talbot
Grand Rapids, MI	Muskegon	Norfolk, VA	Mathews	Washington, DC	Warren
Grand Rapids, MI	Newaygo	Norfolk, VA	Newport New	Washington, DC	Washington
Grand Rapids, MI	Ottawa	Norfolk, VA	Norfolk	Washington, DC	Washington
Grand Traverse Co,MI	Grand Trave	Norfolk, VA	Northampton	Waterbury, CT	Litchfield
Green Bay, WI	Brown	Norfolk, VA	Northumberl	Wheeling, WV	Belmont
Green Bay, WI	Door	Norfolk, VA	Poquoson	Wheeling, WV	Guernsey
Green Bay, WI	Kewaunee	Norfolk, VA	Portsmouth	Wheeling, WV	Marshall
Green Bay, WI	Manitowoc	Norfolk, VA	Southampton	Wheeling, WV	Ohio
Greensboro, NC	Alamance	Norfolk, VA	Suffolk	York, PA	York
Greensboro, NC	Davidson	Norfolk, VA	Surry	Yuba City, CA	Sutter
Greensboro, NC	Davie	Norfolk, VA	Virginia Be	Yuba City, CA	Yuba
Greensboro, NC	Forsyth	Norfolk, VA	Williamsbur		
Greensboro, NC	Guilford	Norfolk, VA	York		

NONATTAINMENT AREAS UNDER THE RCS

	1H1EX-120 (regional)					8H1AX-80 (regional)					8H4AX-80 (regional)					8H5EX-80 (regional)				
		VOC		NOx			VOC		NOx			VOC		NOx			VOC		NOx	
Area	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual
Atlanta, GA						NO			75	46	NO			66	36	NO			62	36
Atlantic City, NJ						NO	79	17			NO	66	17			NO	62	17		
Bakersfield, CA	NO	40	7			NO	40	7			NO	40	7			NO	40	7		
Baltimore/Wash. DC						NO	66	14												
Baton Rouge, LA	YES	18	20			NO	26	13			NO	22	13			YES	18	13		
Beaumont, TX						YES	26	82												
Chicago, IL						NO	44	14												
Cincinnati, OH						YES	35	28												
Dallas, TX						YES	35	27												
Eugene, OR						YES	20	29												
Fairfield, NY						NO	79	11												
Fresno, CA						NO	50	14			NO	45	15			NO	45	15		
Grand Rapids, MI						YES	44	36												
Hartford, CT						NO	79	13												
Houston, TX	YES	44	42			YES	57	42			YES	44	42			YES	44	42		
Huntington, WV						NO	53	28												
Knoxville, TN						YES			53	47										
Los Angeles, CA	NO	80	9			NO	90	9			NO	80	9			NO	80	9		
Manitowoc, WI						NO	44	30												
Modesto, CA						NO	50	11			NO	25	11	50	3					
Muskegon, MI						NO	44	25												
Nashville, TN						YES			44	42										
New London, CT						NO	79	13												
New Orleans, LA						YES	18	19												
New York, NY	NO	62	16			NO	79	16			NO	66	16			NO	62	16		
Philadelphia, PA						NO	62	18			NO	53	18							
Phoenix, AZ						YES	20	42												
Portland, ME						YES			44	33										
Portland, OR						YES	25	28			YES	20	28							
Providence, RI						NO	70	18												
Redding, CA						NO	50	33												
Reno, NV						YES	20	25												
Sacramento, CA						NO	40	9			NO	25	7			NO	20	7		
St. Louis, MO						YES	31	28												
San Diego, CA	NO	80	8			NO	90	8			NO	80	8			NO	80	8		
Santa Barbara, CA						NO	90	9												

NONATTAINMENT AREAS UNDER THE RCS

	1H1EX-120 (regional)					8H1AX-80 (regional)					8H4AX-80 (regional)					8H5EX-80 (regional)				
		VOC		NOx			VOC		NOx			VOC		NOx			VOC		NOx	
Area	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual
Seattle, WA						YES	20	20												
Stockton, CA						NO	50	11												
Visalia, CA						NO	50	7			NO	45	7							
Tell City, IN/KY						YES	18	23												
NUMBER OF NONATTAINMENT AREAS					**6**				**40**					**14**					**10**	
NUMBER OF AREAS THAT CAN ATTAIN					**2**				**16**					**2**					**2**	
NUMBER OF ATTAINING AREAS WITHIN THE RANGE					**1**				**8**					**1**					**2**	
NUMBER OF RESIDUAL NONATTAINMENT AREAS					**4**				**24**					**12**					**8**	

NONATTAINMENT AREAS UNDER THE LCS

Area	1H1EX-120 (regional)					8H1AX-80 (regional)					8H4AX-80 (regional)					8H5EX-80 (regional)				
		VOC		NOx			VOC		NOx			VOC		NOx			VOC		NOx	
	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual
Allentown, PA						NO	90	15												
Athens, GA						NO			85	28	NO			75	29	NO			70	29
Atlanta, GA						NO			85	41	NO			75	43	NO			70	43
Augusta, GA						NO			85	43										
Austin, TX						YES	20	20												
Bakersfield, CA	NO	40	7			NO	40	7			NO	40	7			NO	40	7		
Bangor, ME						NO			50	28	YES			40	32					
Barnstable, MA						YES			50	40										
Baton Rouge, LA	NO	20	13			NO	30	14			NO	25	14			NO	20	14		
Beaumont, TX	YES	20	80			YES	30	68			YES	20	80							
Birmingham, AL						YES			50	45										
Boston, MA	NO			40	24	NO			50	24	NO			45	24	NO			40	24
Charlotte, NC						NO			90	45										
Chattanooga, TN						NO			70	26										
Chicago, IL						NO	50	16			NO	40	16							
Cincinnati, OH						YES	40	32			YES	35	29			YES	30	29		
Columbia, SC						YES			50	50										
Columbus, OH						YES	20	20												
Dallas, TX						YES	40	30			YES	35	29							
Dayton, OH						YES	20	25												
Detroit, MI						NO	50	30												
Dover, DE						NO	90	11												
Eugene, OR						YES	20	29												
Evansville, IN						YES	20	30												
Fresno, CA						NO	50	14			NO	45	15			NO	45	15		
Gadsden, AL						NO			60	31										
Grand Rapids, MI						NO	50	35			YES	40	35			YES	35	35		
Green Bay, WI						NO	50	32												
Greensboro, NC						NO			60	40										
Harrisburg, PA						NO	90	15												
Hartford, CT						NO	90	13			NO	80	13			NO	75	13		
Houston, TX	NO	50	34			NO	65	34			NO	50	34			NO	50	34		
Huntington, WV						NO	60	30			NO	50	28							
Indianapolis, IN						YES	20	20												
Johnson City, TN						YES			60	51										
Knoxville, TN						NO			60	40										

NONATTAINMENT AREAS UNDER THE LCS

	1H1EX-120 (regional)					8H1AX-80 (regional)					8H4AX-80 (regional)					8H5EX-80 (regional)				
		VOC		NOx			VOC		NOx			VOC		NOx			VOC		NOx	
Area	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual
Los Angeles, CA	NO	80	9			NO	90	9			NO	80	9			NO	80	9		
Louisville, KY						NO	50	30												
Macon, GA						NO			80	54	YES			70	56	YES			60	56
Memphis, TN						YES	40	31												
Milwaukee, WI						NO	50	17												
Mobile, AL						YES	10	44												
Modesto, CA						NO	50	11			NO	25	11	50	3					
Nashville, TN						NO			50	32	YES			45	40	YES			40	40
New London, CT	NO	70	14			NO	90	14			NO	75	14			NO	70	14		
New Orleans, LA						YES	20	20												
New York, NY	NO	70	16			NO	90	16			NO	75	17			NO	70	16		
Norfolk, VA						YES			45	35										
Owensboro, KY						YES			50	41	YES			40	41	YES			30	33
Philadelphia, PA	NO	60	18			NO	80	18			NO	70	18			NO	65	18		
Phoenix, AZ						YES	20	42												
Pittsburgh, PA						NO	40	17												
Portland, ME						NO			50	27										
Portland, OR						YES	25	28			YES	20	29							
Providence, RI						NO	80	18			NO	75	18			NO	70	18		
Raleigh, NC						YES			50	45										
Redding, PA						NO	40	16												
Redding, CA						NO	50	33												
Reno, NV						YES	20	25												
Richmond, VA						NO			70	34										
Rochester, NY						YES	40	31												
Sacramento, CA						NO	40	9			NO	25	7			NO	20	7		
St. Louis, MO						YES	35	29												
San Diego, CA	NO	80	8			NO	90	8			NO	80	8			NO	80	8		
Santa Barbara, CA						NO	90	9												
Seattle, WA						YES	20	20												
Sherman, TX						YES	20	21												
Shreveport, LA						YES	20	26												
Springfield, MA						NO			50	21	NO			40	21	NO			35	21
State College, PA						YES	20	20												
Stockton, CA						NO	50	11												
Tulsa, OK						YES	20	30												

NONATTAINMENT AREAS UNDER THE LCS

Area	1H1EX-120 (regional)					8H1AX-80 (regional)					8H4AX-80 (regional)					8H5EX-80 (regional)				
		VOC		NOx			VOC		NOx			VOC		NOx			VOC		NOx	
	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual	Attain?	Target	Actual	Target	Actual
Visalia, CA						NO	50	7			NO	45	7							
Washington, DC						NO	75	17			NO	65	16			NO	60	16		
York, PA						NO	90	14												
NUMBER OF NONATTAINMENT AREAS					**10**				**75**						**30**				**22**	
NUMBER OF AREAS THAT CAN ATTAIN					**1**				**29**						**9**				**5**	
NUMBER OF ATTAINING AREAS WITHIN THE RANGE					**0**				**12**						**3**				**3**	
NUMBER OF RESIDUAL NONATTAINMENT AREAS					**9**				**46**						**21**				**17**	

APPENDIX B

CONTROL MEASURE REDUCTIONS AND COSTS BY NONATTAINMENT AREA

This appendix presents the annual emission reductions and costs associated with the control measures analyzed for each moderate and above nonattainment area identified under each ozone NAAQS alternative. The control measures cover stationary (point and area) and mobile (on-highway and nonroad) sources of VOC and NO_x emissions. To analyze the impacts associated with the current ozone standard and each of the NAAQS alternatives relative to the current standard, VOC and NO_x control measures were developed as surrogates for control measures that State or local agencies may potentially use in their State Implementation Plans (SIPs). The tables in this appendix display the control measures selected for each nonattainment area using a least-cost approach based on the cost-effectiveness value (i.e., the dollar per ton of emission reduction) of each control measure.

Tables B-1 through B-4 show the control measures selected under the regional control scenario (RCS). Tables B-5 through B-8 exhibit the control measures selected under the local control scenario (LCS). Tables B-1 and B-5 display the control measures selected for each area to realize attainment of the current ozone NAAQS. The emission reductions and costs for each control measure are incremental to the 2007 analytical baseline.

Tables B-2 through B-4 and B-6 through B-8 display control measures selected for each NAAQS alternative under the RCS and LCS, respectively. For some nonattainment areas, control measures are listed with zero emission reductions and costs in these tables. The emission reduction and cost values in these tables represent the incremental level of reduction and cost for these measures beyond the level achieved for the current NAAQS. The control measures with zero emission reductions and costs are presented to show the complete list of controls selected toward achievement of the given NAAQS alternative.

Table B-1. Current NAAQS (1H1EX-120): Emission Reductions and Costs by Nonattainment Area and Control Measure Under the RCS

			Reductions (tons per year)		Costs (1990$)	
Nonattainment Area	Source Category	Control Measure	VOC	NOx	VOC	NOx
Bakersfield, CA	Aerosols	CARB Tier 2 Standards - Reform	73.1	0.0	182,664	0
	Aerosols	SCAQMD Standards - Reformulati	73.1	0.0	730,656	0
	Aircraft surface coating	Add-on control levels	2.2	0.0	68,403	0
	Automobile refinishing	CARB BARCT limits	33.3	0.0	122,427	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	127.1	0.0	2,290,251	0
	Metal product surface coating	VOC content limits & improved	21.1	0.0	527	0
	Miscellaneous surface coating	Add-on control levels	21.8	0.0	353,720	0
	Miscellaneous surface coating	MACT level of control	16.0	0.0	40,089	0
	Nonroad gasoline	Reformulated gasoline	37.1	0.0	185,500	0
	Open Burning	Episodic Ban	163.0	30.9	0	0
	Pesticide Application	Reformulation - FIP rule	343.9	0.0	3,198,642	0
	Point Sources	RE Improvements	327.4	0.0	654,810	0
	Recreational vehicles	CARB standards	35.7	0.0	18,962	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	298.1	0.0	7,453	0
	Wood furniture surface coating	Reformulation	44.9	0.0	16,824	0
		Total	1,617.8	30.9	7,870,928	0
Baton Rouge, LA	Aerosols	CARB Tier 2 Standards - Reform	86.2	0.0	215,832	0
	Automobile refinishing	CARB BARCT limits	22.0	0.0	80,538	0
	Metal product surface coating	VOC content limits & improved	57.9	0.0	2,783	0
	Miscellaneous surface coating	MACT level of control	15.6	0.0	38,866	0
	Nonroad gasoline	Reformulated gasoline	58.8	0.0	294,000	0
	Open burning	Seasonal/episodic ban	387.5	73.6	0	0
	Point Sources	RE Improvements	6,853.3	0.0	13,706,480	0
	Recreational vehicles	CARB standards	268.8	0.0	142,458	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	233.8	0.0	5,842	0
	Wood furniture surface coating	Reformulation	4.3	0.0	6,116	0
	Wood product surface coating	Reformulation	1.3	0.0	83	0
		Total	7,989.5	73.6	14,492,998	0
Houston, TX	Aerosols	CARB Tier 2 Standards - Reform	558.0	0.0	1,395,252	0
	Aerosols	SCAQMD Standards - Reformulati	558.0	0.0	5,581,008	0
	Aircraft surface coating	Add-on control levels	0.4	0.0	12,182	0
	Automobile refinishing	CARB BARCT limits	143.2	0.0	526,510	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	546.6	0.0	9,849,515	0
	marine surface coating	Add-on control levels	116.0	0.0	1,680,807	0
	Metal product surface coating	VOC content limits & improved	1,418.3	0.0	46,297	0
	Miscellaneous surface coating	Add-on control levels	68.0	0.0	3,978,067	0
	Miscellaneous surface coating	MACT level of control	603.1	0.0	1,507,620	0
	Nonroad gasoline	Reformulated gasoline	445.1	0.0	2,225,500	0
	Open burning	Seasonal/episodic ban	1,949.0	369.9	0	0
	Paper surface coating	Add-on control levels	23.3	0.0	2,415,926	0
	Pesticide Application	Reformulation - FIP rule	117.3	0.0	1,089,868	0

Table B-1 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Point Source Ind. Surface Coating	Add-on Control Levels	4.4	0.0	80,592	0
	Point Source Metal Surface Coating	FIP VOC Limits	123.4	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	92.7	0.0	2,318	0
	Point Sources	RE Improvements	192,870.8	0.0	385,741,490	0
	Recreational vehicles	CARB standards	707.2	0.0	374,763	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,958.0	0.0	48,969	0
	Wood furniture surface coating	Reformulation	126.3	0.0	180,870	0
	Wood product surface coating	Reformulation	6.4	0.0	272	0
		Total	202,435.5	369.9	416,737,826	0
Los Angeles, CA	Aerosols	CARB Tier 2 Standards - Reform	1,932.3	0.0	4,830,684	0
	Aerosols	SCAQMD Standards - Reformulati	1,932.3	0.0	19,322,736	0
	Aircraft surface coating	Add-on control levels	50.2	0.0	1,580,530	0
	Automobile refinishing	CARB BARCT limits	1,267.4	0.0	4,661,736	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	4,839.0	0.0	87,207,738	0
	marine surface coating	Add-on control levels	105.7	0.0	1,529,243	0
	Metal product surface coating	VOC content limits & improved	2,019.0	0.0	50,468	0
	Miscellaneous surface coating	Add-on control levels	1,712.7	0.0	65,695,922	0
	Miscellaneous surface coating	MACT level of control	1,786.9	0.0	4,467,268	0
	Nonroad gasoline	Reformulated gasoline	1,159.7	0.0	5,798,500	0
	Open Burning	Episodic Ban	5,012.4	952.0	0	0
	Paper surface coating	Add-on control levels	34.8	0.0	2,278,878	0
	Pesticide Application	Reformulation - FIP rule	140.0	0.0	1,301,442	0
	Point Source Ind. Surface Coating	Add-on Control Levels	3,073.1	0.0	56,542,004	0
	Point Source Metal Surface Coating	FIP VOC Limits	1,426.4	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	4,533.3	0.0	113,332	0
	Point Sources	RE Improvements	3,232.8	0.0	6,465,610	0
	Recreational vehicles	CARB standards	257.8	0.0	136,567	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	5,983.2	0.0	149,578	0
	Wood furniture surface coating	Reformulation	3,574.1	0.0	3,554,033	0
	Wood product surface coating	Reformulation	46.6	0.0	1,164	0
		Total	44,119.7	952.0	265,687,433	0
New York, NY	Aerosols	CARB Tier 2 Standards - Reform	2,249.3	0.0	5,622,954	0
	Aerosols	SCAQMD Standards - Reformulati	2,249.4	0.0	22,491,816	0
	Aircraft surface coating	Add-on control levels	62.6	0.0	1,897,352	0
	Automobile refinishing	CARB BARCT limits	1,271.0	0.0	4,674,744	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	4,852.1	0.0	87,451,109	0
	marine surface coating	Add-on control levels	113.1	0.0	1,939,338	0
	Metal product surface coating	VOC content limits & improved	1,411.7	0.0	145,762	0

Table B-1 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Miscellaneous surface coating	Add-on control levels	1,164.2	0.0	52,340,337	0
	Miscellaneous surface coating	MACT level of control	17.7	0.0	44,158	0
	Motor Vehicles	California Reform	5,922.6	34,883.3	0	191,994,283
	Nonroad gasoline	Reformulated gasoline	891.3	0.0	4,456,500	0
	Open Burning	Episodic Ban	9,058.7	1,718.9	0	0
	Paper surface coating	Add-on control levels	193.4	0.0	16,084,868	0
	Pesticide Application	Reformulation - FIP rule	53.7	0.0	497,720	0
	Point Source Ind. Surface Coating	Add-on Control Levels	568.4	0.0	10,456,812	0
	Point Source Metal Surface Coating	FIP VOC Limits	335.1	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	308.1	0.0	7,702	0
	Point Sources	RE Improvements	30,217.3	0.0	60,434,510	0
	Recreational vehicles	CARB standards	1,526.8	0.0	809,122	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	4,984.8	0.0	124,640	0
	Wood furniture surface coating	Reformulation	2,200.0	0.0	2,341,442	0
	Wood product surface coating	Reformulation	34.2	0.0	2,026	0
		Total	69,685.5	36,602.2	271,822,912	191,994,283
San Diego, CA	Aerosols	CARB Tier 2 Standards - Reform	325.4	0.0	813,420	0
	Aerosols	SCAQMD Standards - Reformulati	325.4	0.0	3,253,680	0
	Automobile refinishing	CARB BARCT limits	186.4	0.0	685,506	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	711.6	0.0	12,823,854	0
	Metal product surface coating	VOC content limits & improved	241.3	0.0	6,032	0
	Miscellaneous surface coating	Add-on control levels	179.2	0.0	4,992,999	0
	Miscellaneous surface coating	MACT level of control	396.7	0.0	991,706	0
	Nonroad gasoline	Reformulated gasoline	240.9	0.0	1,204,500	0
	Open Burning	Episodic Ban	679.7	129.1	0	0
	Paper surface coating	Add-on control levels	2.8	0.0	184,069	0
	Pesticide Application	Reformulation - FIP rule	20.4	0.0	189,534	0
	Point Source Ind. Surface Coating	Add-on Control Levels	936.2	0.0	17,226,540	0
	Point Sources	RE Improvements	362.4	0.0	724,890	0
	Recreational vehicles	CARB standards	885.1	0.0	469,092	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	980.6	0.0	24,516	0
	Wood furniture surface coating	Reformulation	734.4	0.0	275,388	0
	Wood product surface coating	Reformulation	6.8	0.0	170	0
		Total	7,215.3	129.1	43,865,896	0

Table B-2. Alternative 8H5EX-80: Marginal Emission Reductions and Costs by Nonattainment Area and Control Measure Under the RCS

			Reductions (tons per year)		Costs (1990$)	
Nonattainment Area	Source Category	Control Measure	VOC	NOx	VOC	NOx
Atlanta, GA	Area Source Industrial NG Comb	RACT to small sources	0.0	19.0	0	32,543
	Cement Manufacturing - Dry	LNB	0.0	141.1	0	118,154
	Cement Manufacturing - Dry	SCR	0.0	169.3	0	1,980,056
	Cement Manufacturing - Dry	SNCR - Urea based	0.0	141.1	0	181,642
	Glass Manufacturing - Container	LNB	0.0	339.2	0	814,003
	Glass Manufacturing - Container	Oxy-Firing	0.0	84.8	0	2,819,334
	Glass Manufacturing - Container	SCR	0.0	296.8	0	1,141,514
	Industrial Boiler - Distillate Oil	LNB + FGR	0.0	1.6	0	16,204
	Industrial Boiler - Distillate Oil	SCR	0.0	3.2	0	34,582
	Industrial Boiler - Natural Gas	LNB + FGR	0.0	23.1	0	147,037
	Industrial Boiler - Natural Gas	SCR	0.0	46.2	0	435,056
	Industrial Boiler - Residual Oil	LNB	0.0	16.3	0	11,879
	Industrial Boiler - Residual Oil	LNB + FGR	0.0	6.5	0	36,100
	Industrial Boiler - Residual Oil	SCR	0.0	13.0	0	93,950
	Motor Vehicles	California Reform	-686.7	13,703.3	0	71,575,206
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	2,793.1	2,205.5	550,208	1,100,415
	Motor Vehicles	Federal Reform	9,129.6	2,704.6	74,646,075	0
	Motor Vehicles	Reform Diesel	0.0	481.5	0	25,282,468
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	309.7	0	2,526,350
	Nonroad gasoline	Reformulated gasoline	271.9	0.0	1,360,000	0
	Open Burning	Episodic Ban	2,033.8	385.8	0	0
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	3.4	0	2,423,615
		Total	13,541.7	21,095.0	76,556,283	110,770,108
Atlantic City, NJ	Aerosols	CARB Tier 2 Standards - Reform	42.3	0.0	105,864	0
	Aerosols	SCAQMD Standards - Reformulati	42.3	0.0	423,456	0
	Automobile refinishing	CARB BARCT limits	18.8	0.0	69,071	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	71.7	0.0	1,292,122	0
	marine surface coating	Add-on control levels	31.3	0.0	722,827	0
	Metal product surface coating	VOC content limits & improved	7.7	0.0	845	0
	Miscellaneous surface coating	Add-on control levels	3.8	0.0	221,789	0
	Motor Vehicles	California Reform	166.3	1,274.4	0	6,071,805
	Nonroad gasoline	Reformulated gasoline	25.9	0.0	129,500	0
	Open Burning	Episodic Ban	243.5	46.2	0	0
	Pesticide Application	Reformulation - FIP rule	6.7	0.0	62,831	0
	Point Sources	RE Improvements	139.4	0.0	278,860	0
	Recreational vehicles	CARB standards	40.2	0.0	21,229	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	321.6	0.0	8,040	0
	Wood furniture surface coating	Reformulation	8.6	0.0	10,454	0
	Wood product surface coating	Reformulation	0.4	0.0	21	0
		Total	1,170.5	1,320.6	3,346,909	6,071,805
Bakersfield, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0

Table B-2 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	1.1	0.0	76,493	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.7	0.0	16	0
		Total	1.8	0.0	76,509	0
Baton Rouge, LA	Aerosols	CARB Tier 2 Standards - Reform	5.3	0.0	13,278	0
	Aerosols	SCAQMD Standards - Reformulati	91.6	0.0	916,440	0
	Automobile refinishing	CARB BARCT limits	0.3	0.0	1,078	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	84.7	0.0	1,526,835	0
	marine surface coating	Add-on control levels	20.4	0.0	295,101	0
	Metal product surface coating	VOC content limits & improved	45.7	0.0	1,419	0
	Miscellaneous surface coating	Add-on control levels	2.3	0.0	160,685	0
	Miscellaneous surface coating	MACT level of control	1.8	0.0	4,378	0
	Motor Vehicles	Federal Reform	1,260.2	385.9	10,568,265	0
	Nonroad gasoline	Reformulated gasoline	5.0	0.0	25,000	0
	Open burning	Seasonal/episodic ban	42.5	8.1	0	0
	Paper surface coating	Add-on control levels	4.5	0.0	467,671	0
	Pesticide Application	Reformulation - FIP rule	36.9	0.0	343,654	0
	Point Sources	RE Improvements	902.3	0.0	1,804,560	0
	Recreational vehicles	CARB standards	23.1	0.0	12,266	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	11.4	0.0	286	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	2,538.0	394.0	16,140,916	0
Fresno, CA	Adhesives - industrial	RACT	1.3	0.0	3,276	0
	Aerosols	CARB Tier 2 Standards - Reform	100.5	0.0	251,094	0
	Aerosols	SCAQMD Standards - Reformulati	100.5	0.0	1,004,376	0
	Automobile refinishing	CARB BARCT limits	51.8	0.0	190,706	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	198.0	0.0	3,567,537	0

Table B-2 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
	Bulk Terminals	RACT	21.8	0.0	36,371	0
	Cutback Asphalt	Switch to emulsified asphalts	14.0	0.0	0	0
	marine surface coating	Add-on control levels	11.1	0.0	160,048	0
	Metal product surface coating	VOC content limits & improved	67.4	0.0	1,680	0
	Miscellaneous surface coating	Add-on control levels	83.5	0.0	1,305,006	0
	Miscellaneous surface coating	MACT level of control	24.1	0.0	60,127	0
	Motor Vehicles	Enhanced I/M	194.8	329.3	77,881	155,763
	Nonroad gasoline	Reformulated gasoline	53.6	0.0	268,000	0
	Open Burning	Episodic Ban	230.7	43.8	0	0
	Paper surface coating	Add-on control levels	4.0	0.0	267,273	0
	Pesticide Application	Reformulation - FIP rule	530.9	0.0	4,937,073	0
	Point Source Metal Surface Coating	FIP VOC Limits	52.6	0.0	0	0
	Point Sources	RE Improvements	3,512.0	0.0	7,024,060	0
	Recreational vehicles	CARB standards	51.9	0.0	27,517	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	339.5	0.0	41,403	0
	Wood furniture surface coating	Reformulation	93.1	0.0	34,896	0
	Wood product surface coating	Reformulation	2.5	0.0	62	0
		Total	5,739.6	373.1	19,258,386	155,763
Houston, TX	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open burning	Seasonal/episodic ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0

Table B-2 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
Los Angeles, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
New York, NY	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0

Table B-2 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Sacramento, CA	Aerosols	CARB Tier 2 Standards - Reform	190.8	0.0	476,892	0
	Aerosols	SCAQMD Standards - Reformulati	190.7	0.0	1,907,568	0
	Automobile refinishing	CARB BARCT limits	123.8	0.0	455,517	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	472.8	0.0	8,521,420	0
	marine surface coating	Add-on control levels	4.2	0.0	60,687	0
	Metal product surface coating	VOC content limits & improved	228.4	0.0	5,663	0
	Miscellaneous surface coating	Add-on control levels	116.6	0.0	1,886,434	0
	Miscellaneous surface coating	MACT level of control	91.7	0.0	229,219	0
	Nonroad gasoline	Reformulated gasoline	101.3	0.0	506,500	0
	Open Burning	Episodic Ban	429.8	81.3	0	0
	Paper surface coating	Add-on control levels	3.1	0.0	206,239	0
	Pesticide Application	Reformulation - FIP rule	113.8	0.0	1,058,898	0
	Point Source Ind. Surface Coating	Add-on Control Levels	361.7	0.0	6,655,556	0
	Point Source Metal Surface Coating	FIP VOC Limits	313.9	0.0	0	0
	Point Sources	RE Improvements	40.5	0.0	81,030	0
	Recreational vehicles	CARB standards	97.3	0.0	51,601	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	646.7	0.0	16,167	0
	Wood furniture surface coating	Reformulation	240.2	0.0	90,098	0
	Wood product surface coating	Reformulation	16.0	0.0	399	0
		Total	3,783.3	81.3	22,209,888	0
San Diego, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0

Table B-2 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0

Table B-3. Alternative 8H4AX-80: Marginal Emission Reductions and Costs by Nonattainment Area and Control Measure Under the RCS

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
Atlanta, GA	Area Source Industrial NG Comb	RACT to small sources	0.0	19.0	0	32,543
	Cement Manufacturing - Dry	LNB	0.0	141.1	0	118,154
	Cement Manufacturing - Dry	SCR	0.0	169.3	0	1,980,056
	Cement Manufacturing - Dry	SNCR - Urea based	0.0	141.1	0	181,642
	Glass Manufacturing - Container	LNB	0.0	339.2	0	814,003
	Glass Manufacturing - Container	Oxy-Firing	0.0	84.8	0	2,819,334
	Glass Manufacturing - Container	SCR	0.0	296.8	0	1,141,514
	Industrial Boiler - Distillate Oil	LNB + FGR	0.0	1.6	0	16,204
	Industrial Boiler - Distillate Oil	SCR	0.0	3.2	0	34,582
	Industrial Boiler - Natural Gas	LNB + FGR	0.0	23.1	0	147,037
	Industrial Boiler - Natural Gas	SCR	0.0	46.2	0	435,056
	Industrial Boiler - Residual Oil	LNB	0.0	16.3	0	11,879
	Industrial Boiler - Residual Oil	LNB + FGR	0.0	6.5	0	36,100
	Industrial Boiler - Residual Oil	SCR	0.0	13.0	0	93,950
	Motor Vehicles	California Reform	-686.7	13,703.3	0	71,575,206
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	2,793.1	2,205.5	550,208	1,100,415
	Motor Vehicles	Federal Reform	9,129.6	2,704.6	74,646,075	0
	Motor Vehicles	Reform Diesel	0.0	481.5	0	25,282,468
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	309.7	0	2,526,350
	Nonroad gasoline	Reformulated gasoline	271.9	0.0	1,360,000	0
	Open Burning	Episodic Ban	2,033.8	385.8	0	0
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	3.4	0	2,423,615
		Total	13,541.7	21,095.0	76,556,283	110,770,108
Atlantic City, NJ	Aerosols	CARB Tier 2 Standards - Reform	42.3	0.0	105,864	0
	Aerosols	SCAQMD Standards - Reformulati	42.3	0.0	423,456	0
	Automobile refinishing	CARB BARCT limits	18.8	0.0	69,071	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	71.7	0.0	1,292,122	0
	marine surface coating	Add-on control levels	31.3	0.0	722,827	0
	Metal product surface coating	VOC content limits & improved	7.7	0.0	845	0
	Miscellaneous surface coating	Add-on control levels	3.8	0.0	221,789	0
	Motor Vehicles	California Reform	166.3	1,274.4	0	6,071,805
	Nonroad gasoline	Reformulated gasoline	25.9	0.0	129,500	0
	Open Burning	Episodic Ban	243.5	46.2	0	0
	Pesticide Application	Reformulation - FIP rule	6.7	0.0	62,831	0
	Point Sources	RE Improvements	139.4	0.0	278,860	0
	Recreational vehicles	CARB standards	40.2	0.0	21,229	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	321.6	0.0	8,040	0
	Wood furniture surface coating	Reformulation	8.6	0.0	10,454	0
	Wood product surface coating	Reformulation	0.4	0.0	21	0
		Total	1,170.5	1,320.6	3,346,909	6,071,805
Bakersfield, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0

Table B-3 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	1.1	0.0	76,493	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.7	0.0	16	0
		Total	1.8	0.0	76,509	0
Baton Rouge, LA	Aerosols	CARB Tier 2 Standards - Reform	5.3	0.0	13,278	0
	Aerosols	SCAQMD Standards - Reformulati	91.6	0.0	916,440	0
	Automobile refinishing	CARB BARCT limits	0.3	0.0	1,078	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	84.7	0.0	1,526,835	0
	marine surface coating	Add-on control levels	20.4	0.0	295,101	0
	Metal product surface coating	VOC content limits & improved	45.7	0.0	1,419	0
	Miscellaneous surface coating	Add-on control levels	2.3	0.0	160,685	0
	Miscellaneous surface coating	MACT level of control	1.8	0.0	4,378	0
	Motor Vehicles	Federal Reform	1,260.2	385.9	10,568,265	0
	Nonroad gasoline	Reformulated gasoline	5.0	0.0	25,000	0
	Open burning	Seasonal/episodic ban	42.5	8.1	0	0
	Paper surface coating	Add-on control levels	4.5	0.0	467,671	0
	Pesticide Application	Reformulation - FIP rule	36.9	0.0	343,654	0
	Point Sources	RE Improvements	902.3	0.0	1,804,560	0
	Recreational vehicles	CARB standards	23.1	0.0	12,266	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	11.4	0.0	286	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	2,538.0	394.0	16,140,916	0
Fresno, CA	Adhesives - industrial	RACT	1.3	0.0	3,276	0
	Aerosols	CARB Tier 2 Standards - Reform	100.5	0.0	251,094	0
	Aerosols	SCAQMD Standards - Reformulati	100.5	0.0	1,004,376	0
	Automobile refinishing	CARB BARCT limits	51.8	0.0	190,706	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	198.0	0.0	3,567,537	0
	Bulk Terminals	RACT	21.8	0.0	36,371	0

Table B-3 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Cutback Asphalt	Switch to emulsified asphalts	14.0	0.0	0	0
	marine surface coating	Add-on control levels	11.1	0.0	160,048	0
	Metal product surface coating	VOC content limits & improved	67.4	0.0	1,680	0
	Miscellaneous surface coating	Add-on control levels	83.5	0.0	1,305,006	0
	Miscellaneous surface coating	MACT level of control	24.1	0.0	60,127	0
	Motor Vehicles	Enhanced I/M	194.8	329.3	77,881	155,763
	Nonroad gasoline	Reformulated gasoline	53.6	0.0	268,000	0
	Open Burning	Episodic Ban	230.7	43.8	0	0
	Paper surface coating	Add-on control levels	4.0	0.0	267,273	0
	Pesticide Application	Reformulation - FIP rule	530.9	0.0	4,937,073	0
	Point Source Metal Surface Coating	FIP VOC Limits	52.6	0.0	0	0
	Point Sources	RE Improvements	3,512.0	0.0	7,024,060	0
	Recreational vehicles	CARB standards	51.9	0.0	27,517	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	339.5	0.0	41,403	0
	Wood furniture surface coating	Reformulation	93.1	0.0	34,896	0
	Wood product surface coating	Reformulation	2.5	0.0	62	0
		Total	5,739.6	373.1	19,258,386	155,763
Houston, TX	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open burning	Seasonal/episodic ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Los Angeles, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0

Table B-3 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Modesto, CA	Aerosols	CARB Tier 2 Standards - Reform	46.7	0.0	116,760	0
	Aerosols	SCAQMD Standards - Reformulati	46.7	0.0	467,040	0
	Automobile refinishing	CARB BARCT limits	30.0	0.0	110,381	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	114.6	0.0	2,064,926	0
	Metal product surface coating	VOC content limits & improved	352.8	0.0	8,725	0
	Miscellaneous surface coating	Add-on control levels	64.2	0.0	1,006,908	0
	Miscellaneous surface coating	MACT level of control	17.1	0.0	42,760	0
	Nonroad gasoline	Reformulated gasoline	25.1	0.0	125,500	0
	Open Burning	Episodic Ban	97.6	18.5	0	0
	Paper surface coating	Add-on control levels	9.4	0.0	632,619	0
	Pesticide Application	Reformulation - FIP rule	108.9	0.0	1,012,621	0
	Point Source Ind. Surface Coating	Add-on Control Levels	74.1	0.0	1,363,348	0
	Point Source Metal Surface Coating	FIP VOC Limits	61.0	0.0	0	0
	Recreational vehicles	CARB standards	24.4	0.0	12,907	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	131.9	0.0	3,297	0
	Wood furniture surface coating	Reformulation	78.4	0.0	29,408	0
	Wood product surface coating	Reformulation	2.5	0.0	63	0
		Total	1,285.4	18.5	6,997,263	0
New York, NY	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0

Table B-3 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Philadelphia, PA	Aerosols	CARB Tier 2 Standards - Reform	849.5	0.0	2,124,030	0
	Aerosols	SCAQMD Standards - Reformulati	849.6	0.0	8,496,120	0
	Aircraft surface coating	Add-on control levels	28.0	0.0	1,012,040	0
	Automobile refinishing	CARB BARCT limits	550.3	0.0	2,023,964	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	2,101.0	0.0	37,862,493	0
	marine surface coating	Add-on control levels	138.1	0.0	2,413,661	0
	Metal product surface coating	VOC content limits & improved	661.9	0.0	23,283	0
	Miscellaneous surface coating	Add-on control levels	369.8	0.0	19,157,461	0
	Miscellaneous surface coating	MACT level of control	49.0	0.0	122,400	0
	Motor Vehicles	California Reform	2,768.4	16,305.2	0	83,136,982
	Nonroad gasoline	Reformulated gasoline	516.8	0.0	2,584,000	0
	Open Burning	Episodic Ban	2,582.6	489.7	0	0
	Paper surface coating	Add-on control levels	68.2	0.0	5,050,766	0
	Pesticide Application	Reformulation - FIP rule	122.7	0.0	1,140,144	0
	Point Source Ind. Surface Coating	Add-on Control Levels	5,061.8	0.0	93,137,488	0
	Point Source Metal Surface Coating	FIP VOC Limits	366.2	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	97.1	0.0	2,427	0
	Point Sources	RE Improvements	30,474.2	0.0	60,948,430	0
	Recreational vehicles	CARB standards	799.6	0.0	423,651	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	2,028.7	0.0	50,721	0

Table B-3 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
	Wood furniture surface coating	Reformulation	841.2	0.0	884,447	0
	Wood product surface coating	Reformulation	13.2	0.0	477	0
		Total	51,337.9	16,794.9	237,458,003	83,136,982
Portland, OR	Bulk Terminals	RACT	219.5	0.0	365,885	0
	Cutback Asphalt	Switch to emulsified asphalts	208.2	0.0	0	0
	Metal product surface coating	VOC content limits & improved	382.9	0.0	9,546	0
	Motor Vehicles	Enhanced I/M	10,296.0	9,747.0	1,458,678	2,917,357
	Open Burning	Episodic Ban	2,140.3	405.9	0	0
	Pharmaceutical manufacture	RACT	4.2	0.0	1,408	0
	Point Source Metal Surface Coating	FIP VOC Limits	139.8	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	217.2	0.0	5,429	0
	Point Sources	RE Improvements	19,187.0	0.0	38,373,910	0
	Recreational vehicles	CARB standards	379.1	0.0	200,932	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,190.7	0.0	381,602	0
	SOCMI fugitives	RACT	12.7	0.0	1,729	0
	Web Offset Lithography	New CTG (carbon adsorber)	249.0	0.0	-31,123	0
	Wood furniture surface coating	Reformulation	466.6	0.0	175,013	0
	Wood product surface coating	Reformulation	42.0	0.0	1,745	0
		Total	35,135.2	10,152.9	40,944,754	2,917,357
Sacramento, CA	Aerosols	CARB Tier 2 Standards - Reform	190.8	0.0	476,892	0
	Aerosols	SCAQMD Standards - Reformulati	190.7	0.0	1,907,568	0
	Automobile refinishing	CARB BARCT limits	123.8	0.0	455,517	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	472.8	0.0	8,521,420	0
	marine surface coating	Add-on control levels	4.2	0.0	60,687	0
	Metal product surface coating	VOC content limits & improved	228.4	0.0	5,663	0
	Miscellaneous surface coating	Add-on control levels	116.6	0.0	1,886,434	0
	Miscellaneous surface coating	MACT level of control	91.7	0.0	229,219	0
	Nonroad gasoline	Reformulated gasoline	101.3	0.0	506,500	0
	Open Burning	Episodic Ban	429.8	81.3	0	0
	Paper surface coating	Add-on control levels	3.1	0.0	206,239	0
	Pesticide Application	Reformulation - FIP rule	113.8	0.0	1,058,898	0
	Point Source Ind. Surface Coating	Add-on Control Levels	361.7	0.0	6,655,556	0
	Point Source Metal Surface Coating	FIP VOC Limits	313.9	0.0	0	0
	Point Sources	RE Improvements	40.5	0.0	81,030	0
	Recreational vehicles	CARB standards	97.3	0.0	51,601	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	646.7	0.0	16,167	0
	Wood furniture surface coating	Reformulation	240.2	0.0	90,098	0
	Wood product surface coating	Reformulation	16.0	0.0	399	0
		Total	3,783.3	81.3	22,209,888	0

Table B-3 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
San Diego, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Visalia, CA	Aerosols	CARB Tier 2 Standards - Reform	42.6	0.0	106,380	0
	Automobile refinishing	CARB BARCT limits	11.2	0.0	41,327	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	42.9	0.0	773,106	0
	Metal product surface coating	VOC content limits & improved	49.9	0.0	1,238	0
	Miscellaneous surface coating	Add-on control levels	22.0	0.0	333,737	0
	Miscellaneous surface coating	MACT level of control	19.7	0.0	49,270	0
	Nonroad gasoline	Reformulated gasoline	23.1	0.0	115,500	0
	Open Burning	Episodic Ban	93.7	17.7	0	0
	Paper surface coating	Add-on control levels	1.1	0.0	76,493	0
	Pesticide Application	Reformulation - FIP rule	250.4	0.0	2,329,073	0
	Recreational vehicles	CARB standards	22.4	0.0	11,867	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	110.8	0.0	2,770	0
	Wood furniture surface coating	Reformulation	8.2	0.0	3,088	0
	Wood product surface coating	Reformulation	2.7	0.0	67	0
		Total	700.7	17.7	3,843,916	0

Table B-4. Alternative 8H1AX-80: Marginal Emission Reductions and Costs by Nonattainment Area and Control Measure Under the RCS

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
Atlanta, GA	Area Source Industrial NG Comb	RACT to small sources	0.0	40.0	0	68,692
	Cement Manufacturing - Dry	LNB	0.0	141.1	0	118,154
	Cement Manufacturing - Dry	SCR	0.0	169.3	0	1,980,056
	Cement Manufacturing - Dry	SNCR - Urea based	0.0	141.1	0	181,642
	Glass Manufacturing - Container	LNB	0.0	339.2	0	814,003
	Glass Manufacturing - Container	Oxy-Firing	0.0	84.8	0	2,819,334
	Glass Manufacturing - Container	SCR	0.0	296.8	0	1,141,514
	Industrial Boiler - Distillate Oil	LNB	0.0	16.2	0	22,570
	Industrial Boiler - Distillate Oil	LNB + FGR	0.0	4.5	0	44,896
	Industrial Boiler - Distillate Oil	SCR	0.0	9.1	0	95,822
	Industrial Boiler - Natural Gas	LNB	0.0	76.1	0	69,300
	Industrial Boiler - Natural Gas	LNB + FGR	0.0	38.1	0	237,338
	Industrial Boiler - Natural Gas	SCR	0.0	76.2	0	702,239
	Industrial Boiler - PC	LNB	0.0	229.5	0	369,572
	Industrial Boiler - PC	SCR	0.0	68.9	0	1,770,659
	Industrial Boiler - PC	SNCR	0.0	45.9	0	569,962
	Industrial Boiler - Residual Oil	LNB	0.0	175.3	0	129,287
	Industrial Boiler - Residual Oil	LNB + FGR	0.0	38.3	0	209,562
	Industrial Boiler - Residual Oil	SCR	0.0	76.6	0	545,406
	Motor Vehicles	California Reform	-715.0	14,570.6	0	75,035,816
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	4,867.6	3,819.7	952,657	1,905,313
	Motor Vehicles	Federal Reform	9,600.3	2,839.1	78,262,901	0
	Motor Vehicles	Reform Diesel	0.0	520.4	0	27,274,484
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	326.6	0	2,664,317
	Nonroad gasoline	Reformulated gasoline	286.4	0.0	1,432,000	0
	Open Burning	Episodic Ban	2,436.9	462.1	0	0
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	3.4	0	2,423,615
		Total	16,476.2	24,608.9	80,647,558	121,193,553
Atlantic City, NJ	Aerosols	CARB Tier 2 Standards - Reform	42.3	0.0	105,864	0
	Aerosols	SCAQMD Standards - Reformulati	42.3	0.0	423,456	0
	Automobile refinishing	CARB BARCT limits	18.8	0.0	69,071	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	71.7	0.0	1,292,122	0
	marine surface coating	Add-on control levels	31.3	0.0	722,827	0
	Metal product surface coating	VOC content limits & improved	7.7	0.0	845	0
	Miscellaneous surface coating	Add-on control levels	3.8	0.0	221,789	0
	Motor Vehicles	California Reform	166.3	1,274.4	0	6,071,805
	Nonroad gasoline	Reformulated gasoline	25.9	0.0	129,500	0
	Open Burning	Episodic Ban	243.5	46.2	0	0
	Pesticide Application	Reformulation - FIP rule	6.7	0.0	62,831	0
	Point Sources	RE Improvements	139.4	0.0	278,860	0
	Recreational vehicles	CARB standards	40.2	0.0	21,229	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	321.6	0.0	8,040	0
	Wood furniture surface coating	Reformulation	8.6	0.0	10,454	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Wood product surface coating	Reformulation	0.4	0.0	21	0
		Total	1,170.5	1,320.6	3,346,909	6,071,805
Bakersfield, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.7	0.0	16	0
		Total	0.7	0.0	16	0
Baltimore-Washington, DC	Adhesives - industrial	RACT	2.9	0.0	7,333	0
	Aerosols	CARB Tier 2 Standards - Reform	838.8	0.0	2,096,568	0
	Aerosols	SCAQMD Standards - Reformulati	838.9	0.0	8,386,272	0
	Aircraft surface coating	Add-on control levels	20.3	0.0	727,841	0
	Automobile refinishing	CARB BARCT limits	441.1	0.0	1,622,379	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	1,683.9	0.0	30,350,042	0
	Cutback Asphalt	Switch to emulsified asphalts	11.6	0.0	0	0
	marine surface coating	Add-on control levels	116.2	0.0	1,679,127	0
	Metal product surface coating	VOC content limits & improved	600.4	0.0	26,412	0
	Miscellaneous surface coating	Add-on control levels	260.3	0.0	5,369,000	0
	Miscellaneous surface coating	MACT level of control	131.2	0.0	327,585	0
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	4,219.6	4,304.6	1,004,762	2,009,525
	Motor Vehicles	Federal Reform	449.5	131.0	3,989,469	0
	Nonroad gasoline	Reformulated gasoline	541.9	0.0	2,709,500	0
	Open Burning	Episodic Ban	829.7	158.1	0	0
	Paper surface coating	Add-on control levels	40.0	0.0	2,915,609	0
	Pesticide Application	Reformulation - FIP rule	272.8	0.0	2,535,796	0
	Point Source Ind. Surface Coating	Add-on Control Levels	147.5	0.0	2,713,264	0
	Point Source Metal Surface Coating	FIP VOC Limits	824.2	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	7.3	0.0	183	0
	Point Sources	RE Improvements	5,980.0	0.0	11,960,320	0
	Recreational vehicles	CARB standards	785.1	0.0	416,107	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
	Service stations - stage I-truck un	Vapor balance & P-V valves	2,761.0	0.0	80,261	0
	Web Offset Lithography	New CTG (carbon adsorber)	0.4	0.0	-45	0
	Wood furniture surface coating	Reformulation	1,033.9	0.0	395,887	0
	Wood product surface coating	Reformulation	18.6	0.0	602	0
		Total	22,857.1	4,593.7	79,314,274	2,009,525
Baton Rouge, LA	Aerosols	CARB Tier 2 Standards - Reform	5.3	0.0	13,278	0
	Aerosols	SCAQMD Standards - Reformulati	91.6	0.0	916,440	0
	Automobile refinishing	CARB BARCT limits	0.3	0.0	1,078	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	84.7	0.0	1,526,835	0
	marine surface coating	Add-on control levels	20.4	0.0	295,101	0
	Metal product surface coating	VOC content limits & improved	45.7	0.0	1,419	0
	Miscellaneous surface coating	Add-on control levels	2.3	0.0	160,685	0
	Miscellaneous surface coating	MACT level of control	1.8	0.0	4,378	0
	Motor Vehicles	Federal Reform	1,260.2	385.9	10,568,265	0
	Nonroad gasoline	Reformulated gasoline	5.0	0.0	25,000	0
	Open burning	Seasonal/episodic ban	42.5	8.1	0	0
	Paper surface coating	Add-on control levels	4.5	0.0	467,671	0
	Pesticide Application	Reformulation - FIP rule	36.9	0.0	343,654	0
	Point Sources	RE Improvements	902.3	0.0	1,804,560	0
	Recreational vehicles	CARB standards	23.1	0.0	12,266	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	11.4	0.0	286	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	2,538.0	394.0	16,140,916	0
Beaumont, TX	Metal product surface coating	VOC content limits & improved	43.3	0.0	1,746	0
	Open Burning	Episodic Ban	313.4	59.3	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	22.6	0.0	0	0
	Point Sources	RE Improvements	96,693.2	0.0	193,386,490	0
	Recreational vehicles	CARB standards	69.9	0.0	36,998	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	220.0	0.0	5,502	0
	Wood furniture surface coating	Reformulation	6.7	0.0	9,574	0
	Wood product surface coating	Reformulation	0.8	0.0	27	0
		Total	97,369.9	59.3	193,440,337	0
Chicago, IL	Adhesives - industrial	RACT	17.5	0.0	43,823	0
	Aerosols	CARB Tier 2 Standards - Reform	1,188.1	0.0	2,969,826	0
	Aerosols	SCAQMD Standards - Reformulati	1,188.1	0.0	11,879,304	0
	Aircraft surface coating	Add-on control levels	8.5	0.0	288,264	0
	Automobile refinishing	CARB BARCT limits	662.6	0.0	2,436,920	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	2,529.6	0.0	45,587,801	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Bulk Terminals	RACT	89.0	0.0	148,271	0
	Cutback Asphalt	Switch to emulsified asphalts	27.3	0.0	0	0
	marine surface coating	Add-on control levels	99.5	0.0	1,440,735	0
	Metal product surface coating	VOC content limits & improved	3,362.5	0.0	119,678	0
	Miscellaneous surface coating	Add-on control levels	1,416.8	0.0	36,920,959	0
	Miscellaneous surface coating	MACT level of control	1,271.3	0.0	3,177,986	0
	Motor Vehicles	California Reform	3,819.6	21,388.4	0	110,921,385
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	357.5	304.4	75,325	150,650
	Motor Vehicles	Federal Reform	70.8	24.8	679,832	0
	Nonroad gasoline	Reformulated gasoline	567.8	0.0	2,839,000	0
	Open Burning	Episodic Ban	2,378.8	451.4	0	0
	Paper surface coating	Add-on control levels	25.4	0.0	2,636,415	0
	Pesticide Application	Reformulation - FIP rule	314.4	0.0	2,923,605	0
	Point Source Ind. Surface Coating	Add-on Control Levels	3,315.7	0.0	61,008,144	0
	Point Source Metal Surface Coating	FIP VOC Limits	6,953.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	78.8	0.0	1,971	0
	Point Sources	RE Improvements	9,246.9	0.0	18,493,820	0
	Recreational vehicles	CARB standards	1,358.2	0.0	719,732	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	3,158.0	0.0	139,715	0
	Web Offset Lithography	New CTG (carbon adsorber)	2.6	0.0	-326	0
	Wood furniture surface coating	Reformulation	1,097.1	0.0	1,485,499	0
	Wood product surface coating	Reformulation	25.3	0.0	650	0
		Total	44,630.7	22,169.0	196,016,949	111,072,035
Cincinnati, OH	Adhesives - industrial	RACT	79.4	0.0	198,526	0
	Aerosols	CARB Tier 2 Standards - Reform	270.2	0.0	675,798	0
	Aerosols	SCAQMD Standards - Reformulati	270.2	0.0	2,703,192	0
	Aircraft surface coating	Add-on control levels	51.8	0.0	1,873,198	0
	Automobile refinishing	CARB BARCT limits	100.6	0.0	370,237	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	384.2	0.0	6,926,038	0
	Bulk Terminals	RACT	134.5	0.0	224,072	0
	Cutback Asphalt	Switch to emulsified asphalts	70.0	0.0	0	0
	marine surface coating	Add-on control levels	9.9	0.0	143,004	0
	Metal product surface coating	VOC content limits & improved	233.8	0.0	6,817	0
	Miscellaneous surface coating	Add-on control levels	323.3	0.0	11,922,127	0
	Miscellaneous surface coating	MACT level of control	42.5	0.0	106,099	0
	Motor Vehicles	California Reform	955.8	6,134.8	0	30,656,109
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	18,368.9	13,119.3	675,395	1,350,789
	Motor Vehicles	Federal Reform	3,876.3	938.1	26,812,203	0
	Nonroad gasoline	Reformulated gasoline	138.6	0.0	693,000	0
	Open Burning	Episodic Ban	1,973.1	375.1	0	0
	Paper surface coating	Add-on control levels	43.0	0.0	3,019,753	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Pesticide Application	Reformulation - FIP rule	95.9	0.0	890,829	0
	Point Source Ind. Surface Coating	Add-on Control Levels	155.1	0.0	2,854,300	0
	Point Source Metal Surface Coating	FIP VOC Limits	455.9	0.0	0	0
	Point Sources	RE Improvements	857.1	0.0	1,714,040	0
	Recreational vehicles	CARB standards	202.5	0.0	107,319	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	852.4	0.0	119,526	0
	Web Offset Lithography	New CTG (carbon adsorber)	8.0	0.0	-989	0
	Wood furniture surface coating	Reformulation	746.9	0.0	315,871	0
	Wood product surface coating	Reformulation	8.7	0.0	228	0
		Total	30,708.6	20,567.3	62,350,583	32,006,898
Dallas, TX	Adhesives - industrial	RACT	206.5	0.0	516,108	0
	Aerosols	CARB Tier 2 Standards - Reform	569.3	0.0	1,423,242	0
	Aerosols	SCAQMD Standards - Reformulati	569.2	0.0	5,692,968	0
	Aircraft surface coating	Add-on control levels	10.9	0.0	344,747	0
	Automobile refinishing	CARB BARCT limits	275.8	0.0	1,014,479	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	1,053.2	0.0	18,977,998	0
	Bulk Terminals	RACT	443.3	0.0	738,704	0
	Cutback Asphalt	Switch to emulsified asphalts	348.1	0.0	0	0
	marine surface coating	Add-on control levels	15.1	0.0	218,518	0
	Metal product surface coating	VOC content limits & improved	1,160.4	0.0	41,375	0
	Miscellaneous surface coating	Add-on control levels	738.0	0.0	17,418,524	0
	Miscellaneous surface coating	MACT level of control	836.2	0.0	2,090,260	0
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	32,776.9	29,743.0	2,029,995	4,059,989
	Motor Vehicles	Federal Reform	1,320.5	283.2	7,756,926	0
	Nonroad gasoline	Reformulated gasoline	478.5	0.0	2,392,500	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	34.9	0.0	13,809	0
	Open Burning	Episodic Ban	2,152.8	408.2	0	0
	Paper surface coating	Add-on control levels	69.3	0.0	6,065,109	0
	Pesticide Application	Reformulation - FIP rule	153.4	0.0	1,426,100	0
	Petroleum refinery fugitives	RACT	167.1	0.0	-75,186	0
	Pharmaceutical manufacture	RACT	1.3	0.0	417	0
	Point Source Ind. Surface Coating	Add-on Control Levels	4,042.7	0.0	74,386,416	0
	Point Source Metal Surface Coating	FIP VOC Limits	204.0	0.0	0	0
	Point Source Open Burning	Episodic Ban	9.1	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	208.0	0.0	5,202	0
	Point Sources	RE Improvements	14,125.2	0.0	28,250,270	0
	Recreational vehicles	CARB standards	761.1	0.0	403,346	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	2,505.1	0.0	592,835	0
	SOCMI batch reactor processes	New CTG	1.7	0.0	7,007	0
	SOCMI fugitives	RACT	1.0	0.0	141	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
	Web Offset Lithography	New CTG (carbon adsorber)	30.3	0.0	-3,789	0
	Wood furniture surface coating	Reformulation	695.0	0.0	586,526	0
	Wood product surface coating	Reformulation	15.0	0.0	857	0
		Total	65,978.9	30,434.4	172,315,404	4,059,989
Eugene, OR	Adhesives - industrial	RACT	398.9	0.0	997,164	0
	Aerosols	CARB Tier 2 Standards - Reform	67.3	0.0	168,276	0
	Automobile refinishing	CARB BARCT limits	27.4	0.0	100,653	0
	Bulk Terminals	RACT	173.6	0.0	289,200	0
	Cutback Asphalt	Switch to emulsified asphalts	351.5	0.0	0	0
	Metal product surface coating	VOC content limits & improved	92.8	0.0	2,314	0
	Miscellaneous surface coating	MACT level of control	49.2	0.0	122,853	0
	Motor Vehicles	Enhanced I/M	2,659.9	2,365.1	951,535	1,903,069
	Nonroad gasoline	Reformulated gasoline	34.8	0.0	174,000	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	1.2	0.0	470	0
	Open Burning	Episodic Ban	473.9	89.9	0	0
	Recreational vehicles	CARB standards	75.8	0.0	40,095	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	358.9	0.0	186,182	0
	Web Offset Lithography	New CTG (carbon adsorber)	67.6	0.0	-8,447	0
	Wood furniture surface coating	Reformulation	114.8	0.0	43,029	0
	Wood product surface coating	Reformulation	58.6	0.0	1,464	0
		Total	5,006.2	2,455.0	3,068,788	1,903,069
Fairfield, CT	Aerosols	CARB Tier 2 Standards - Reform	104.9	0.0	262,200	0
	Aerosols	SCAQMD Standards - Reformulati	104.9	0.0	1,048,800	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	173.8	0.0	5,062,064	0
	Metal product surface coating	VOC content limits & improved	82.5	0.0	11,089	0
	Miscellaneous surface coating	Add-on control levels	45.0	0.0	2,937,767	0
	Motor Vehicles	California Reform	414.2	2,580.7	0	14,343,658
	Nonroad gasoline	Reformulated gasoline	71.6	0.0	358,000	0
	Paper surface coating	Add-on control levels	3.1	0.0	313,572	0
	Pesticide Application	Reformulation - FIP rule	1.0	0.0	8,816	0
	Point Source Ind. Surface Coating	Add-on Control Levels	39.4	0.0	725,328	0
	Recreational vehicles	CARB standards	218.0	0.0	115,514	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	349.8	0.0	8,745	0
	Wood furniture surface coating	Reformulation	23.6	0.0	37,782	0
	Wood product surface coating	Reformulation	3.1	0.0	80	0
		Total	1,634.9	2,580.7	10,889,757	14,343,658
Fresno, CA	Adhesives - industrial	RACT	14.2	0.0	35,444	0
	Aerosols	CARB Tier 2 Standards - Reform	119.6	0.0	298,638	0
	Aerosols	SCAQMD Standards - Reformulati	119.6	0.0	1,194,552	0
	Automobile refinishing	CARB BARCT limits	58.9	0.0	217,170	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	225.5	0.0	4,062,635	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
	Bulk Terminals	RACT	57.2	0.0	95,380	0
	Cutback Asphalt	Switch to emulsified asphalts	57.0	0.0	0	0
	marine surface coating	Add-on control levels	11.1	0.0	160,048	0
	Metal product surface coating	VOC content limits & improved	77.5	0.0	1,931	0
	Miscellaneous surface coating	Add-on control levels	93.6	0.0	1,460,681	0
	Miscellaneous surface coating	MACT level of control	27.8	0.0	69,321	0
	Motor Vehicles	Enhanced I/M	750.9	1,264.0	298,651	597,301
	Nonroad gasoline	Reformulated gasoline	63.0	0.0	315,000	0
	Open Burning	Episodic Ban	276.4	52.4	0	0
	Paper surface coating	Add-on control levels	4.5	0.0	298,193	0
	Pesticide Application	Reformulation - FIP rule	742.3	0.0	6,903,465	0
	Point Source Metal Surface Coating	FIP VOC Limits	52.6	0.0	0	0
	Point Sources	RE Improvements	3,519.3	0.0	7,038,660	0
	Recreational vehicles	CARB standards	60.8	0.0	32,225	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	454.2	0.0	103,431	0
	Web Offset Lithography	New CTG (carbon adsorber)	4.1	0.0	-508	0
	Wood furniture surface coating	Reformulation	102.1	0.0	38,279	0
	Wood product surface coating	Reformulation	6.2	0.0	154	0
		Total	6,898.4	1,316.4	22,623,350	597,301
Grand Rapids, MI	Adhesives - industrial	RACT	130.6	0.0	326,390	0
	Aerosols	CARB Tier 2 Standards - Reform	102.6	0.0	256,368	0
	Aerosols	SCAQMD Standards - Reformulati	102.6	0.0	1,025,472	0
	Aircraft surface coating	Add-on control levels	3.7	0.0	132,865	0
	Automobile refinishing	CARB BARCT limits	62.2	0.0	228,904	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	237.6	0.0	4,282,146	0
	Cutback Asphalt	Switch to emulsified asphalts	85.3	0.0	0	0
	marine surface coating	Add-on control levels	68.1	0.0	985,510	0
	Metal product surface coating	VOC content limits & improved	199.1	0.0	4,981	0
	Miscellaneous surface coating	Add-on control levels	1,366.5	0.0	31,117,326	0
	Motor Vehicles	California Reform	364.6	2,984.1	0	13,408,026
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	8,035.8	5,841.0	409,302	818,603
	Motor Vehicles	Federal Reform	1,844.4	488.6	13,996,171	0
	Nonroad gasoline	Reformulated gasoline	101.6	0.0	508,000	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	37.2	0.0	14,770	0
	Open Burning	Episodic Ban	648.1	122.9	0	0
	Paper surface coating	Add-on control levels	22.2	0.0	1,402,309	0
	Pesticide Application	Reformulation - FIP rule	72.5	0.0	673,506	0
	Pharmaceutical manufacture	RACT	138.2	0.0	46,285	0
	Point Sources	RE Improvements	6,025.1	0.0	12,050,110	0
	Recreational vehicles	CARB standards	548.1	0.0	290,468	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	292.2	0.0	7,305	0
	Web Offset Lithography	New CTG (carbon adsorber)	8.5	0.0	-1,067	0
	Wood furniture surface coating	Reformulation	4,967.9	0.0	1,862,987	0
	Wood product surface coating	Reformulation	6.5	0.0	298	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
		Total	25,471.2	9,436.6	69,620,406	14,226,629
Hartford, CT	Aerosols	CARB Tier 2 Standards - Reform	159.0	0.0	397,518	0
	Aerosols	SCAQMD Standards - Reformulati	159.1	0.0	1,590,072	0
	Aircraft surface coating	Add-on control levels	116.4	0.0	6,094,635	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	298.6	0.0	8,697,450	0
	Metal product surface coating	VOC content limits & improved	103.8	0.0	13,957	0
	Miscellaneous surface coating	Add-on control levels	88.4	0.0	6,479,450	0
	Motor Vehicles	California Reform	708.0	4,400.2	0	22,365,569
	Nonroad gasoline	Reformulated gasoline	112.5	0.0	562,500	0
	Open Burning	Episodic Ban	890.4	168.9	0	0
	Paper surface coating	Add-on control levels	22.7	0.0	2,278,121	0
	Pesticide Application	Reformulation - FIP rule	15.3	0.0	141,676	0
	Point Source Ind. Surface Coating	Add-on Control Levels	5.8	0.0	107,456	0
	Point Source Metal Surface Coating	FIP VOC Limits	102.9	0.0	0	0
	Recreational vehicles	CARB standards	342.0	0.0	181,179	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	508.9	0.0	12,723	0
	Wood furniture surface coating	Reformulation	92.0	0.0	146,938	0
	Wood product surface coating	Reformulation	5.5	0.0	136	0
		Total	3,731.3	4,569.1	26,703,811	22,365,569
Houston, TX	Adhesives - industrial	RACT	27.2	0.0	68,115	0
	Aerosols	CARB Tier 2 Standards - Reform	17.9	0.0	44,754	0
	Aerosols	SCAQMD Standards - Reformulati	17.8	0.0	179,016	0
	Automobile refinishing	CARB BARCT limits	2.7	0.0	10,196	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	10.6	0.0	190,748	0
	Bulk Terminals	RACT	203.7	0.0	339,507	0
	Cutback Asphalt	Switch to emulsified asphalts	112.6	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	5.1	0.0	129	0
	Miscellaneous surface coating	Add-on control levels	2.6	0.0	46,902	0
	Miscellaneous surface coating	MACT level of control	2.2	0.0	5,479	0
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	1,635.5	1,168.2	291,551	583,101
	Motor Vehicles	Federal Reform	456.6	99.0	2,622,337	0
	Nonroad gasoline	Reformulated gasoline	13.7	0.0	68,500	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	11.8	0.0	4,674	0
	Open burning	Seasonal/episodic ban	73.7	13.8	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	105.6	0.0	981,616	0
	Point Source Ind. Surface Coating	Add-on Control Levels	85.0	0.0	1,564,828	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	62.8	0.0	1,570	0
	Point Sources	RE Improvements	0.0	0.0	0	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Recreational vehicles	CARB standards	21.5	0.0	11,363	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	260.9	0.0	195,467	0
	Web Offset Lithography	New CTG (carbon adsorber)	10.5	0.0	-1,319	0
	Wood furniture surface coating	Reformulation	12.1	0.0	4,536	0
	Wood product surface coating	Reformulation	1.5	0.0	38	0
		Total	3,153.6	1,281.0	6,630,007	583,101
Huntington, WV	Adhesives - industrial	RACT	23.8	0.0	59,522	0
	Aerosols	CARB Tier 2 Standards - Reform	51.1	0.0	127,602	0
	Aerosols	SCAQMD Standards - Reformulati	51.1	0.0	510,408	0
	Automobile refinishing	CARB BARCT limits	12.6	0.0	46,575	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	48.4	0.0	871,265	0
	Bulk Terminals	RACT	36.6	0.0	60,913	0
	Cutback Asphalt	Switch to emulsified asphalts	77.5	0.0	0	0
	marine surface coating	Add-on control levels	5.7	0.0	82,393	0
	Metal product surface coating	VOC content limits & improved	43.3	0.0	1,721	0
	Miscellaneous surface coating	Add-on control levels	10.0	0.0	164,121	0
	Miscellaneous surface coating	MACT level of control	13.7	0.0	34,223	0
	Motor Vehicles	California Reform	145.1	1,267.4	0	5,466,889
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	3,256.8	2,435.5	263,196	526,392
	Motor Vehicles	Federal Reform	729.3	205.3	5,708,990	0
	Nonroad gasoline	Reformulated gasoline	23.7	0.0	118,500	0
	Oiland natural gas production fiel	RACT (equipment/maintenance)	0.5	0.0	188	0
	Open Burning	Episodic Ban	443.0	83.6	0	0
	Paper surface coating	Add-on control levels	0.5	0.0	38,060	0
	Pesticide Application	Reformulation - FIP rule	4.3	0.0	39,618	0
	Point Source Ind. Surface Coating	Add-on Control Levels	12.4	0.0	228,344	0
	Point Sources	RE Improvements	6,281.0	0.0	12,561,840	0
	Recreational vehicles	CARB standards	34.0	0.0	18,019	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	241.6	0.0	93,577	0
	SOCMI batch reactor processes	New CTG	105.1	0.0	426,152	0
	SOCMI fugitives	RACT	61.3	0.0	8,345	0
	Web Offset Lithography	New CTG (carbon adsorber)	8.7	0.0	-1,087	0
	Wood furniture surface coating	Reformulation	26.8	0.0	10,523	0
		Total	11,747.9	3,991.8	21,473,008	5,993,281
Knoxville, TN	Adhesives - industrial	RACT	329.4	0.0	823,688	0
	Aerosols	CARB Tier 2 Standards - Reform	108.5	0.0	271,524	0
	Aerosols	SCAQMD Standards - Reformulati	108.5	0.0	1,086,096	0
	Aircraft surface coating	Add-on control levels	4.0	0.0	125,719	0
	Area Source Industrial Coal Comb	RACT to small sources	0.0	22.7	0	88,259
	Area Source Industrial Oil Comb	RACT to small sources	0.0	0.8	0	1,758
	Automobile refinishing	CARB BARCT limits	33.1	0.0	121,990	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	126.6	0.0	2,282,141	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Cement Manufacturing - Dry	LNB	0.0	262.9	0	210,670
	Cement Manufacturing - Dry	SCR	0.0	315.5	0	3,530,444
	Cement Manufacturing - Dry	SNCR - Urea based	0.0	262.9	0	323,865
	Commercial Marine Vessels	Emission Fees	0.0	33.2	0	331,535
	Cutback Asphalt	Switch to emulsified asphalts	280.6	0.0	0	0
	Industrial Boiler - Distillate Oil	LNB	0.0	2.2	0	3,080
	Industrial Boiler - Distillate Oil	LNB + FGR	0.0	0.5	0	4,283
	Industrial Boiler - Distillate Oil	SCR	0.0	0.9	0	9,136
	Industrial Boiler - Natural Gas	LNB	0.0	31.2	0	28,823
	Industrial Boiler - Natural Gas	LNB + FGR	0.0	6.2	0	38,107
	Industrial Boiler - Natural Gas	SCR	0.0	12.6	0	112,742
	Industrial Boiler - PC	LNB	0.0	884.5	0	1,421,744
	Industrial Boiler - PC	SCR	0.0	265.4	0	6,811,724
	Industrial Boiler - PC	SNCR	0.0	176.9	0	2,192,644
	Industrial Boiler - Residual Oil	LNB	0.0	16.2	0	12,168
	Industrial Boiler - Residual Oil	LNB + FGR	0.0	6.2	0	34,572
	Industrial Boiler - Residual Oil	SCR	0.0	12.6	0	89,980
	Industrial Boiler - Stoker	SCR	0.0	90.9	0	905,202
	Industrial Boiler - Stoker	SNCR	0.0	113.6	0	244,779
	marine surface coating	Add-on control levels	122.4	0.0	1,771,300	0
	Metal product surface coating	VOC content limits & improved	167.1	0.0	8,216	0
	Miscellaneous surface coating	Add-on control levels	179.3	0.0	8,570,343	0
	Miscellaneous surface coating	MACT level of control	32.9	0.0	82,138	0
	Motor Vehicles	California Reform	-113.2	3,111.8	0	14,082,175
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	8,942.2	6,407.4	1,648,631	3,297,263
	Motor Vehicles	Federal Reform	1,943.4	541.8	14,703,239	0
	Motor Vehicles	Reform Diesel	0.0	131.0	0	6,648,656
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	67.8	0	553,880
	Nonroad gasoline	Reformulated gasoline	58.7	0.0	293,500	0
	Open Burning	Episodic Ban	938.2	177.9	0	0
	Paper surface coating	Add-on control levels	13.5	0.0	308,857	0
	Pesticide Application	Reformulation - FIP rule	9.3	0.0	86,601	0
	Point Source Ind. Surface Coating	Add-on Control Levels	864.0	0.0	15,896,772	0
	Process Heaters - Natural Gas	LNB + SCR	0.0	10.9	0	304,598
	Process Heaters - Natural Gas	ULNB	0.0	62.7	0	40,020
	Recreational vehicles	CARB standards	42.8	0.0	22,703	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	358.2	0.0	8,956	0
	Web Offset Lithography	New CTG (carbon adsorber)	79.9	0.0	-9,997	0
	Wood furniture surface coating	Reformulation	284.6	0.0	106,743	0
	Wood product surface coating	Reformulation	2.1	0.0	135	0
		Total	14,916.1	13,029.2	48,209,295	41,322,107
Los Angeles, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Manitowoc, WI	Aerosols	CARB Tier 2 Standards - Reform	19.9	0.0	49,596	0
	Aerosols	SCAQMD Standards - Reformulati	19.9	0.0	198,384	0
	Automobile refinishing	CARB BARCT limits	8.1	0.0	29,881	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	31.0	0.0	558,983	0
	marine surface coating	Add-on control levels	96.5	0.0	1,395,871	0
	Metal product surface coating	VOC content limits & improved	34.7	0.0	865	0
	Miscellaneous surface coating	Add-on control levels	31.5	0.0	547,300	0
	Miscellaneous surface coating	MACT level of control	56.8	0.0	142,041	0
	Motor Vehicles	California Reform	56.6	580.5	0	2,299,274
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	1,274.4	1,030.2	91,780	183,560
	Motor Vehicles	Federal Reform	304.4	88.5	2,403,498	0
	Nonroad gasoline	Reformulated gasoline	15.4	0.0	77,000	0
	Open Burning	Episodic Ban	163.5	30.9	0	0
	Paper surface coating	Add-on control levels	1.1	0.0	75,421	0
	Pesticide Application	Reformulation - FIP rule	34.9	0.0	324,459	0
	Point Source Ind. Surface Coating	Add-on Control Levels	104.4	0.0	1,920,776	0
	Point Source Metal Surface Coating	FIP VOC Limits	16.4	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	17.9	0.0	447	0
	Recreational vehicles	CARB standards	40.7	0.0	21,584	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	48.6	0.0	1,220	0
	Web Offset Lithography	New CTG (carbon adsorber)	2.5	0.0	-312	0
	Wood furniture surface coating	Reformulation	116.4	0.0	43,659	0
	Wood product surface coating	Reformulation	2.0	0.0	50	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
		Total	2,497.6	1,730.1	7,882,503	2,482,834
Modesto, CA	Aerosols	CARB Tier 2 Standards - Reform	46.7	0.0	116,760	0
	Aerosols	SCAQMD Standards - Reformulati	46.7	0.0	467,040	0
	Automobile refinishing	CARB BARCT limits	30.0	0.0	110,381	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	114.6	0.0	2,064,926	0
	Metal product surface coating	VOC content limits & improved	352.8	0.0	8,725	0
	Miscellaneous surface coating	Add-on control levels	64.2	0.0	1,006,908	0
	Miscellaneous surface coating	MACT level of control	17.1	0.0	42,760	0
	Nonroad gasoline	Reformulated gasoline	25.1	0.0	125,500	0
	Open Burning	Episodic Ban	97.6	18.5	0	0
	Paper surface coating	Add-on control levels	9.4	0.0	632,619	0
	Pesticide Application	Reformulation - FIP rule	108.9	0.0	1,012,621	0
	Point Source Ind. Surface Coating	Add-on Control Levels	74.1	0.0	1,363,348	0
	Point Source Metal Surface Coating	FIP VOC Limits	61.0	0.0	0	0
	Recreational vehicles	CARB standards	24.4	0.0	12,907	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	131.9	0.0	3,297	0
	Wood furniture surface coating	Reformulation	78.4	0.0	29,408	0
	Wood product surface coating	Reformulation	2.5	0.0	63	0
		Total	1,285.4	18.5	6,997,263	0
Muskegon, MI	Aerosols	CARB Tier 2 Standards - Reform	22.1	0.0	55,344	0
	Aerosols	SCAQMD Standards - Reformulati	22.1	0.0	221,376	0
	Aircraft surface coating	Add-on control levels	1.9	0.0	67,602	0
	Automobile refinishing	CARB BARCT limits	11.9	0.0	43,723	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	45.4	0.0	817,916	0
	Miscellaneous surface coating	Add-on control levels	98.5	0.0	3,018,808	0
	Motor Vehicles	California Reform	60.2	608.9	0	2,717,140
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	1,589.5	1,175.3	47,591	95,182
	Motor Vehicles	Federal Reform	350.5	99.1	2,836,015	0
	Nonroad gasoline	Reformulated gasoline	20.9	0.0	104,500	0
	Open Burning	Episodic Ban	190.1	35.9	0	0
	Paper surface coating	Add-on control levels	6.2	0.0	414,248	0
	Pesticide Application	Reformulation - FIP rule	8.6	0.0	79,850	0
	Recreational vehicles	CARB standards	111.9	0.0	59,310	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	63.7	0.0	1,594	0
	Wood furniture surface coating	Reformulation	406.8	0.0	152,532	0
		Total	3,010.3	1,919.2	7,920,409	2,812,322
Nashville, TN	Area Source Industrial Coal Comb	RACT to small sources	0.0	27.7	0	107,750
	Area Source Industrial Oil Comb	RACT to small sources	0.0	0.5	0	1,073
	Commercial Marine Vessels	Emission Fees	0.0	27.6	0	274,516
	Gas Turbines - Natural Gas	SCR + STEAM INJECTION	0.0	37.3	0	801,585
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	246.5	0	5,652,452
	IC Engines - Natural Gas	NSCR	0.0	491.3	0	1,241,469

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Industrial Boiler - Distillate Oil	LNB + FGR	0.0	6.3	0	64,698
	Industrial Boiler - Distillate Oil	SCR	0.0	12.6	0	138,075
	Industrial Boiler - Natural Gas	LNB	0.0	6.8	0	6,100
	Industrial Boiler - Natural Gas	LNB + FGR	0.0	69.0	0	438,362
	Industrial Boiler - Natural Gas	SCR	0.0	138.0	0	1,297,032
	Industrial Boiler - PC	SCR	0.0	66.6	0	1,794,222
	Industrial Boiler - PC	SNCR	0.0	44.4	0	577,548
	Industrial Boiler - Residual Oil	LNB + FGR	0.0	1.7	0	9,893
	Industrial Boiler - Residual Oil	SCR	0.0	3.5	0	25,747
	Industrial Boiler - Stoker	SCR	0.0	39.7	0	413,030
	Motor Vehicles	California Reform	-162.8	4,007.3	0	20,150,267
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	11,604.1	8,719.2	567,807	1,135,614
	Motor Vehicles	Federal Reform	2,630.3	768.2	21,020,978	0
	Motor Vehicles	Reform Diesel	0.0	152.3	0	7,739,306
	Municipal Waste Combustors	SNCR	0.0	131.6	0	439,269
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	104.6	0	852,643
	Nonroad gasoline	Reformulated gasoline	91.6	0.0	458,000	0
	Open Burning	Episodic Ban	746.4	141.4	0	0
	Process Heaters - Distillate Oil	LNB + SCR	0.0	0.0	0	1,637
	Process Heaters - Natural Gas	LNB + SCR	0.0	5.4	0	170,509
	Process Heaters - Natural Gas	ULNB	0.0	5.9	0	3,734
		Total	14,909.6	15,255.4	22,046,785	43,336,531
New London, CT	Aerosols	CARB Tier 2 Standards - Reform	158.8	0.0	396,912	0
	Aerosols	SCAQMD Standards - Reformulati	158.8	0.0	1,587,648	0
	Aircraft surface coating	Add-on control levels	13.4	0.0	704,628	0
	Automobile refinishing	CARB BARCT limits	6.5	0.0	24,006	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	238.2	0.0	6,660,863	0
	marine surface coating	Add-on control levels	2.9	0.0	41,886	0
	Metal product surface coating	VOC content limits & improved	283.2	0.0	16,501	0
	Miscellaneous surface coating	Add-on control levels	71.7	0.0	6,276,407	0
	Miscellaneous surface coating	MACT level of control	19.7	0.0	49,140	0
	Motor Vehicles	California Reform	630.1	3,961.2	0	20,401,080
	Nonroad gasoline	Reformulated gasoline	164.1	0.0	820,500	0
	Open Burning	Episodic Ban	849.4	161.1	0	0
	Paper surface coating	Add-on control levels	24.2	0.0	2,346,314	0
	Pesticide Application	Reformulation - FIP rule	10.1	0.0	93,725	0
	Point Source Ind. Surface Coating	Add-on Control Levels	97.8	0.0	1,799,888	0
	Point Sources	RE Improvements	1,007.7	0.0	2,015,530	0
	Recreational vehicles	CARB standards	604.1	0.0	320,133	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	460.7	0.0	11,517	0
	Wood furniture surface coating	Reformulation	77.4	0.0	122,710	0
	Wood product surface coating	Reformulation	5.3	0.0	130	0
		Total	4,884.1	4,122.3	23,288,438	20,401,080
New Orleans, LA	Cutback Asphalt	Switch to emulsified asphalts	1,068.4	0.0	0	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Metal product surface coating	VOC content limits & improved	277.9	0.0	9,701	0
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	11,508.4	6,549.1	1,773,573	3,547,145
	Oil and natural gas production fiel	RACT (equipment/maintenance)	268.9	0.0	106,656	0
	Open Burning	Episodic Ban	1,167.1	221.5	0	0
	Pharmaceutical manufacture	RACT	5.7	0.0	1,878	0
	Point Source Metal Surface Coating	FIP VOC Limits	20.4	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	598.5	0.0	14,963	0
	Web Offset Lithography	New CTG (carbon adsorber)	115.6	0.0	-14,447	0
	Wood product surface coating	Reformulation	1.4	0.0	89	0
		Total	15,032.3	6,770.6	1,892,413	3,547,145
New York, NY	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Philadelphia, PA	Aerosols	CARB Tier 2 Standards - Reform	849.5	0.0	2,124,030	0
	Aerosols	SCAQMD Standards - Reformulati	849.6	0.0	8,496,120	0
	Aircraft surface coating	Add-on control levels	28.0	0.0	1,012,040	0
	Automobile refinishing	CARB BARCT limits	550.3	0.0	2,023,964	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	2,101.0	0.0	37,862,493	0
	marine surface coating	Add-on control levels	138.1	0.0	2,413,661	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Metal product surface coating	VOC content limits & improved	661.9	0.0	23,283	0
	Miscellaneous surface coating	Add-on control levels	369.8	0.0	19,157,461	0
	Miscellaneous surface coating	MACT level of control	49.0	0.0	122,400	0
	Motor Vehicles	California Reform	2,768.4	16,305.2	0	83,136,982
	Nonroad gasoline	Reformulated gasoline	516.8	0.0	2,584,000	0
	Open Burning	Episodic Ban	2,582.6	489.7	0	0
	Paper surface coating	Add-on control levels	68.2	0.0	5,050,766	0
	Pesticide Application	Reformulation - FIP rule	122.7	0.0	1,140,144	0
	Point Source Ind. Surface Coating	Add-on Control Levels	5,061.8	0.0	93,137,488	0
	Point Source Metal Surface Coating	FIP VOC Limits	366.2	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	97.1	0.0	2,427	0
	Point Sources	RE Improvements	30,474.2	0.0	60,948,430	0
	Recreational vehicles	CARB standards	799.6	0.0	423,651	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	2,028.7	0.0	50,721	0
	Wood furniture surface coating	Reformulation	841.2	0.0	884,447	0
	Wood product surface coating	Reformulation	13.2	0.0	477	0
		Total	51,337.9	16,794.9	237,458,003	83,136,982
Phoenix, AZ	Adhesives - industrial	RACT	39.2	0.0	98,028	0
	Aerosols	CARB Tier 2 Standards - Reform	402.0	0.0	1,004,856	0
	Automobile refinishing	CARB BARCT limits	182.6	0.0	671,796	0
	Bulk Terminals	RACT	115.1	0.0	191,712	0
	Cutback Asphalt	Switch to emulsified asphalts	109.7	0.0	0	0
	Metal product surface coating	VOC content limits & improved	521.6	0.0	12,986	0
	Miscellaneous surface coating	MACT level of control	417.7	0.0	1,044,188	0
	Motor Vehicles	Enhanced I/M	21,094.9	12,639.6	1,199,840	2,399,679
	Motor Vehicles	Federal Reform	36,455.7	3,002.3	47,793,100	0
	Nonroad gasoline	Reformulated gasoline	306.9	0.0	1,534,500	0
	Open Burning	Episodic Ban	1,589.9	303.4	0	0
	Recreational vehicles	CARB standards	318.6	0.0	168,875	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,131.7	0.0	212,983	0
	Web Offset Lithography	New CTG (carbon adsorber)	6.4	0.0	-795	0
	Wood furniture surface coating	Reformulation	891.0	0.0	334,128	0
	Wood product surface coating	Reformulation	23.1	0.0	576	0
		Total	63,606.1	15,945.3	54,266,773	2,399,679
Portland, ME	Area Source Industrial Coal Comb	RACT to small sources	0.0	0.1	0	235
	Area Source Industrial NG Comb	RACT to small sources	0.0	1.6	0	2,349
	Area Source Industrial Oil Comb	RACT to small sources	0.0	3.7	0	7,486
	Commercial Marine Vessels	Emission Fees	0.0	90.8	0	907,683
	Industrial Boiler - Distillate Oil	LNB + FGR	0.0	2.9	0	29,602

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Industrial Boiler - Distillate Oil	SCR	0.0	5.8	0	63,175
	Industrial Boiler - Natural Gas	LNB + FGR	0.0	0.9	0	5,706
	Industrial Boiler - Natural Gas	SCR	0.0	1.8	0	16,880
	Industrial Boiler - Residual Oil	LNB + FGR	0.0	66.3	0	379,442
	Industrial Boiler - Residual Oil	SCR	0.0	132.5	0	987,553
	Motor Vehicles	California Reform	208.9	1,844.3	0	7,957,384
	Motor Vehicles	Reform Diesel	0.0	81.5	0	4,121,838
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	4.0	0	33,035
	Nonroad gasoline	Reformulated gasoline	23.3	0.0	117,000	0
	Open Burning	Episodic Ban	801.7	152.3	0	0
	Residential NG Consumption	LNB Space heaters	0.0	12.5	0	20,258
	Utility Boiler - Oil-Gas/Tangential	LNB + FGR + OFA	0.0	58.2	0	977,858
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	181.7	0	2,235,995
		Total	1,033.9	2,640.9	117,000	17,746,479
Portland, OR	Bulk Terminals	RACT	364.1	0.0	606,885	0
	Cutback Asphalt	Switch to emulsified asphalts	320.2	0.0	0	0
	Metal product surface coating	VOC content limits & improved	406.7	0.0	10,136	0
	Motor Vehicles	Enhanced I/M	11,068.2	10,483.5	1,747,796	3,495,591
	Open Burning	Episodic Ban	2,265.5	429.5	0	0
	Pharmaceutical manufacture	RACT	4.2	0.0	1,408	0
	Point Source Metal Surface Coating	FIP VOC Limits	139.8	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	217.2	0.0	5,429	0
	Point Sources	RE Improvements	19,187.0	0.0	38,373,910	0
	Recreational vehicles	CARB standards	403.8	0.0	214,057	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,432.7	0.0	562,989	0
	SOCMI fugitives	RACT	12.7	0.0	1,729	0
	Web Offset Lithography	New CTG (carbon adsorber)	259.3	0.0	-32,399	0
	Wood furniture surface coating	Reformulation	487.7	0.0	182,937	0
	Wood product surface coating	Reformulation	43.4	0.0	1,779	0
		Total	36,612.5	10,913.0	41,676,656	3,495,591
Providence, RI	Aerosols	CARB Tier 2 Standards - Reform	133.1	0.0	332,580	0
	Aerosols	SCAQMD Standards - Reformulati	133.1	0.0	1,330,320	0
	Aircraft surface coating	Add-on control levels	0.2	0.0	4,764	0
	Automobile refinishing	CARB BARCT limits	83.6	0.0	307,511	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	319.2	0.0	5,752,666	0
	marine surface coating	Add-on control levels	131.6	0.0	1,905,058	0
	Metal product surface coating	VOC content limits & improved	285.3	0.0	7,100	0
	Miscellaneous surface coating	Add-on control levels	193.3	0.0	3,130,460	0
	Miscellaneous surface coating	MACT level of control	129.2	0.0	323,006	0
	Motor Vehicles	California Reform	410.5	2,548.7	0	13,834,606
	Nonroad gasoline	Reformulated gasoline	101.8	0.0	509,000	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Open Burning	Episodic Ban	510.9	97.1	0	0
	Paper surface coating	Add-on control levels	0.8	0.0	50,406	0
	Pesticide Application	Reformulation - FIP rule	1.6	0.0	15,196	0
	Point Source Ind. Surface Coating	Add-on Control Levels	177.8	0.0	3,270,692	0
	Point Source Metal Surface Coating	FIP VOC Limits	129.6	0.0	0	0
	Point Sources	RE Improvements	2,381.3	0.0	4,762,520	0
	Recreational vehicles	CARB standards	545.9	0.0	289,257	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	313.0	0.0	7,823	0
	Wood furniture surface coating	Reformulation	402.2	0.0	150,805	0
	Wood product surface coating	Reformulation	5.1	0.0	130	0
		Total	6,389.1	2,645.8	22,149,294	13,834,606
Redding, CA	Adhesives - industrial	RACT	97.0	0.0	242,361	0
	Aerosols	CARB Tier 2 Standards - Reform	26.1	0.0	65,190	0
	Aerosols	SCAQMD Standards - Reformulati	26.1	0.0	260,760	0
	Automobile refinishing	CARB BARCT limits	12.7	0.0	46,813	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	48.6	0.0	875,746	0
	Bulk Terminals	RACT	303.5	0.0	505,794	0
	Cutback Asphalt	Switch to emulsified asphalts	180.7	0.0	0	0
	marine surface coating	Add-on control levels	6.4	0.0	93,094	0
	Metal product surface coating	VOC content limits & improved	18.8	0.0	468	0
	Miscellaneous surface coating	Add-on control levels	8.6	0.0	133,220	0
	Miscellaneous surface coating	MACT level of control	3.7	0.0	9,223	0
	Motor Vehicles	Enhanced I/M	2,316.3	3,420.1	841,481	1,682,962
	Nonroad gasoline	Reformulated gasoline	13.7	0.0	68,500	0
	Open Burning	Episodic Ban	15.6	3.0	0	0
	Paper surface coating	Add-on control levels	64.3	0.0	774,483	0
	Pesticide Application	Reformulation - FIP rule	24.2	0.0	225,693	0
	Recreational vehicles	CARB standards	12.8	0.0	6,824	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	731.0	0.0	547,670	0
	Web Offset Lithography	New CTG (carbon adsorber)	14.3	0.0	-1,791	0
	Wood furniture surface coating	Reformulation	7.4	0.0	2,761	0
	Wood product surface coating	Reformulation	8.3	0.0	208	0
		Total	3,940.1	3,423.1	4,698,498	1,682,962
Reno, NV	Aerosols	CARB Tier 2 Standards - Reform	44.1	0.0	110,244	0
	Automobile refinishing	CARB BARCT limits	30.8	0.0	113,240	0
	Metal product surface coating	VOC content limits & improved	37.5	0.0	934	0
	Miscellaneous surface coating	MACT level of control	30.7	0.0	76,867	0
	Motor Vehicles	Enhanced I/M	1,537.1	1,483.5	94,145	188,291
	Motor Vehicles	Federal Reform	1,919.7	357.6	5,606,016	0
	Nonroad gasoline	Reformulated gasoline	39.8	0.0	199,000	0
	Open Burning	Episodic Ban	82.3	15.6	0	0
	Recreational vehicles	CARB standards	118.5	0.0	62,805	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Service stations - stage I-truck un	Vapor balance & P-V valves	153.1	0.0	3,845	0
	Web Offset Lithography	New CTG (carbon adsorber)	97.0	0.0	-12,130	0
	Wood furniture surface coating	Reformulation	68.8	0.0	25,794	0
	Wood product surface coating	Reformulation	2.0	0.0	50	0
		Total	4,161.4	1,856.7	6,280,810	188,291
Sacramento, CA	Adhesives - industrial	RACT	34.5	0.0	86,360	0
	Aerosols	CARB Tier 2 Standards - Reform	201.3	0.0	503,034	0
	Aerosols	SCAQMD Standards - Reformulati	201.2	0.0	2,012,136	0
	Automobile refinishing	CARB BARCT limits	127.1	0.0	467,563	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	485.3	0.0	8,746,744	0
	Bulk Terminals	RACT	12.8	0.0	21,347	0
	Cutback Asphalt	Switch to emulsified asphalts	72.2	0.0	0	0
	marine surface coating	Add-on control levels	4.2	0.0	60,687	0
	Metal product surface coating	VOC content limits & improved	236.7	0.0	5,867	0
	Miscellaneous surface coating	Add-on control levels	119.5	0.0	1,938,485	0
	Miscellaneous surface coating	MACT level of control	105.2	0.0	262,951	0
	Motor Vehicles	Enhanced I/M	828.8	1,377.3	326,808	653,615
	Nonroad gasoline	Reformulated gasoline	106.5	0.0	532,500	0
	Open Burning	Episodic Ban	444.0	84.0	0	0
	Paper surface coating	Add-on control levels	3.1	0.0	206,239	0
	Pesticide Application	Reformulation - FIP rule	114.2	0.0	1,062,488	0
	Point Source Ind. Surface Coating	Add-on Control Levels	361.7	0.0	6,655,556	0
	Point Source Metal Surface Coating	FIP VOC Limits	313.9	0.0	0	0
	Point Sources	RE Improvements	40.5	0.0	81,030	0
	Recreational vehicles	CARB standards	102.4	0.0	54,329	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	799.0	0.0	130,285	0
	Web Offset Lithography	New CTG (carbon adsorber)	6.6	0.0	-825	0
	Wood furniture surface coating	Reformulation	252.5	0.0	94,698	0
	Wood product surface coating	Reformulation	16.0	0.0	399	0
		Total	4,989.2	1,461.3	23,248,681	653,615
San Diego, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Santa Barbara, CA	Aerosols	CARB Tier 2 Standards - Reform	50.1	0.0	125,256	0
	Aerosols	SCAQMD Standards - Reformulati	50.1	0.0	501,024	0
	Aircraft surface coating	Add-on control levels	10.5	0.0	330,223	0
	Automobile refinishing	CARB BARCT limits	25.1	0.0	92,413	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	95.9	0.0	1,728,785	0
	Metal product surface coating	VOC content limits & improved	44.0	0.0	1,098	0
	Miscellaneous surface coating	Add-on control levels	18.2	0.0	303,110	0
	Miscellaneous surface coating	MACT level of control	45.7	0.0	114,149	0
	Motor Vehicles	Enhanced I/M	1,827.6	2,680.2	106,112	212,224
	Nonroad gasoline	Reformulated gasoline	26.0	0.0	130,000	0
	Open Burning	Episodic Ban	134.4	25.5	0	0
	Paper surface coating	Add-on control levels	1.3	0.0	84,224	0
	Pesticide Application	Reformulation - FIP rule	34.8	0.0	323,156	0
	Point Sources	RE Improvements	91.6	0.0	183,230	0
	Recreational vehicles	CARB standards	5.8	0.0	3,072	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	196.0	0.0	4,901	0
	Wood furniture surface coating	Reformulation	52.3	0.0	19,616	0
	Wood product surface coating	Reformulation	1.6	0.0	40	0
		Total	2,711.0	2,705.7	4,050,409	212,224
Seattle, WA	Adhesives - industrial	RACT	105.8	0.0	264,172	0
	Aerosols	CARB Tier 2 Standards - Reform	467.2	0.0	1,167,756	0
	Aerosols	SCAQMD Standards - Reformulati	467.0	0.0	4,671,024	0
	Automobile refinishing	CARB BARCT limits	250.9	0.0	922,119	0
	Bulk Terminals	RACT	248.4	0.0	413,881	0
	Cutback Asphalt	Switch to emulsified asphalts	454.5	0.0	0	0
	Metal product surface coating	VOC content limits & improved	578.7	0.0	14,445	0
	Miscellaneous surface coating	MACT level of control	240.4	0.0	601,215	0
	Motor Vehicles	California LEV	8,992.7	15,879.0	12,434,797	12,434,797
	Motor Vehicles	California Reform	1,615.1	4,241.6	0	65,175,421
	Motor Vehicles	Enhanced I/M	4,292.7	3,491.0	1,372,151	2,744,303
	Motor Vehicles	Federal Reform	11,865.0	3,331.6	67,981,645	0
	Nonroad gasoline	Reformulated gasoline	292.5	0.0	1,462,500	0
	Open Burning	Episodic Ban	1,232.7	233.9	0	0
	Pesticide Application	Reformulation - FIP rule	71.3	0.0	662,233	0
	Point Source Metal Surface Coating	FIP VOC Limits	8.8	0.0	0	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
	Point Source Wood Product Coating	FIP VOC Limits	93.1	0.0	2,327	0
	Recreational vehicles	CARB standards	628.9	0.0	333,244	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	2,104.6	0.0	699,089	0
	Web Offset Lithography	New CTG (carbon adsorber)	532.5	0.0	-66,548	0
	Wood furniture surface coating	Reformulation	989.4	0.0	371,013	0
	Wood product surface coating	Reformulation	22.6	0.0	1,182	0
		Total	35,554.8	27,177.1	93,308,245	80,354,520
St. Louis, MO	Adhesives - industrial	RACT	18.4	0.0	45,877	0
	Aerosols	CARB Tier 2 Standards - Reform	364.1	0.0	910,368	0
	Aerosols	SCAQMD Standards - Reformulati	364.1	0.0	3,641,472	0
	Aircraft surface coating	Add-on control levels	120.4	0.0	3,790,114	0
	Automobile refinishing	CARB BARCT limits	183.9	0.0	676,359	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	702.2	0.0	12,652,662	0
	Cutback Asphalt	Switch to emulsified asphalts	48.5	0.0	0	0
	marine surface coating	Add-on control levels	17.2	0.0	249,014	0
	Metal product surface coating	VOC content limits & improved	836.5	0.0	35,843	0
	Miscellaneous surface coating	Add-on control levels	241.9	0.0	15,971,880	0
	Miscellaneous surface coating	MACT level of control	176.0	0.0	440,252	0
	Motor Vehicles	California Reform	24.8	8,761.5	0	45,829,827
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	26,691.5	19,604.6	948,486	1,896,971
	Motor Vehicles	Federal Reform	6,064.0	1,717.0	47,795,117	0
	Nonroad gasoline	Reformulated gasoline	151.4	0.0	757,000	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	4.2	0.0	1,690	0
	Open Burning	Episodic Ban	1,607.9	304.9	0	0
	Paper surface coating	Add-on control levels	23.6	0.0	2,442,361	0
	Pesticide Application	Reformulation - FIP rule	217.1	0.0	2,019,308	0
	Point Source Ind. Surface Coating	Add-on Control Levels	7,192.0	0.0	132,332,064	0
	Point Source Metal Surface Coating	FIP VOC Limits	874.2	0.0	0	0
	Point Sources	RE Improvements	3,298.8	0.0	6,597,740	0
	Recreational vehicles	CARB standards	253.0	0.0	133,902	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,235.8	0.0	30,896	0
	Web Offset Lithography	New CTG (carbon adsorber)	2.2	0.0	-281	0
	Wood furniture surface coating	Reformulation	335.3	0.0	482,482	0
	Wood product surface coating	Reformulation	6.8	0.0	168	0
		Total	51,055.8	30,388.0	231,954,774	47,726,798
Stockton, CA	Aerosols	CARB Tier 2 Standards - Reform	63.9	0.0	159,828	0
	Aerosols	SCAQMD Standards - Reformulati	63.9	0.0	639,312	0
	Automobile refinishing	CARB BARCT limits	30.9	0.0	113,829	0

Table B-4 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
	Automobile refinishing	FIP Rule (VOC Content & TE)	118.2	0.0	2,129,416	0
	marine surface coating	Add-on control levels	2.6	0.0	37,680	0
	Metal product surface coating	VOC content limits & improved	315.6	0.0	7,806	0
	Miscellaneous surface coating	Add-on control levels	86.9	0.0	1,429,779	0
	Miscellaneous surface coating	MACT level of control	38.0	0.0	94,975	0
	Nonroad gasoline	Reformulated gasoline	32.9	0.0	164,500	0
	Open Burning	Episodic Ban	146.1	27.8	0	0
	Paper surface coating	Add-on control levels	5.3	0.0	358,421	0
	Pesticide Application	Reformulation - FIP rule	162.5	0.0	1,510,952	0
	Point Source Wood Product Coating	FIP VOC Limits	138.0	0.0	3,449	0
	Recreational vehicles	CARB standards	31.5	0.0	16,720	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	184.4	0.0	4,610	0
	Wood furniture surface coating	Reformulation	214.0	0.0	80,240	0
		Total	1,634.7	27.8	6,751,517	0
Tell City (IN-KY)	Cutback Asphalt	Switch to emulsified asphalts	40.9	0.0	0	0
	Metal product surface coating	VOC content limits & improved	9.8	0.0	323	0
	Motor Vehicles	Enhanced I/M (w/49 State LEV)	626.6	531.0	130,727	261,453
	Oil and natural gas production fiel	RACT (equipment/maintenance)	2.2	0.0	840	0
	Open Burning	Episodic Ban	73.8	13.9	0	0
	Petroleum refinery fugitives	RACT	52.5	0.0	-23,622	0
	Point Source Metal Surface Coating	FIP VOC Limits	220.4	0.0	0	0
	Web Offset Lithography	New CTG (carbon adsorber)	14.8	0.0	-1,846	0
	Wood furniture surface coating	Reformulation	118.8	0.0	44,537	0
		Total	1,159.8	544.9	150,959	261,453
Visalia, CA	Aerosols	CARB Tier 2 Standards - Reform	42.6	0.0	106,380	0
	Aerosols	SCAQMD Standards - Reformulati	42.6	0.0	425,520	0
	Automobile refinishing	CARB BARCT limits	11.2	0.0	41,327	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	42.9	0.0	773,106	0
	Metal product surface coating	VOC content limits & improved	49.9	0.0	1,238	0
	Miscellaneous surface coating	Add-on control levels	22.0	0.0	333,737	0
	Miscellaneous surface coating	MACT level of control	19.7	0.0	49,270	0
	Nonroad gasoline	Reformulated gasoline	23.1	0.0	115,500	0
	Open Burning	Episodic Ban	93.7	17.7	0	0
	Pesticide Application	Reformulation - FIP rule	250.4	0.0	2,329,073	0
	Recreational vehicles	CARB standards	22.4	0.0	11,867	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	110.8	0.0	2,770	0
	Wood furniture surface coating	Reformulation	8.2	0.0	3,088	0
	Wood product surface coating	Reformulation	2.7	0.0	67	0
		Total	742.2	17.7	4,192,943	0

Table B-5. Current NAAQS (1H1EX-120): Emission Reductions and Costs by Nonattainment Area and Control Measure Under the LCS

			Reductions (tons per year)		Costs (1990$)	
Nonattainment Area	Source Category	Control Measure	VOC	NOx	VOC	NOx
Bakersfield, CA	Aerosols	SCAQMD Standards - Reformulati	146.2	0.0	0	913,320
	Aircraft surface coating	Add-on control levels	2.2	0.0	0	68,403
	Automobile refinishing	FIP Rule (VOC Content & TE)	160.4	0.0	0	2,412,678
	Metal product surface coating	VOC content limits & improved	21.1	0.0	0	527
	Miscellaneous surface coating	Add-on control levels	21.8	0.0	0	353,720
	Miscellaneous surface coating	MACT level of control	16.0	0.0	0	40,089
	Nonroad gasoline	Reformulated gasoline	37.1	0.0	0	185,500
	Open Burning	Episodic Ban	163.0	30.9	0	0
	Pesticide Application	Reformulation - FIP rule	343.9	0.0	0	3,198,642
	Point Sources	RE Improvements	327.4	0.0	0	654,810
	Recreational vehicles	CARB standards	35.7	0.0	0	18,962
	Service stations - stage I-truck un	Vapor balance & P-V valves	298.1	0.0	0	7,453
	Wood furniture surface coating	Reformulation	44.9	0.0	0	16,824
		Total	1,617.8	30.9	0	7,870,928
Baton Rouge, LA	Aerosols	CARB Tier 2 Standards - Reform	95.4	0.0	238,926	0
	Aerosols	SCAQMD Standards - Reformulati	95.5	0.0	955,704	0
	Automobile refinishing	CARB BARCT limits	22.6	0.0	82,694	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	85.8	0.0	1,547,000	0
	marine surface coating	Add-on control levels	20.4	0.0	295,101	0
	Metal product surface coating	VOC content limits & improved	103.9	0.0	4,224	0
	Miscellaneous surface coating	Add-on control levels	2.3	0.0	160,685	0
	Miscellaneous surface coating	MACT level of control	17.4	0.0	43,244	0
	Motor Vehicles	California LEV	1,452.2	2,588.1	2,029,332	2,029,332
	Motor Vehicles	Federal Reform	1,561.9	538.1	11,154,029	0
	Nonroad gasoline	Reformulated gasoline	67.5	0.0	337,500	0
	Open Burning	Episodic Ban	463.5	88.1	0	0
	Paper surface coating	Add-on control levels	4.5	0.0	467,671	0
	Pesticide Application	Reformulation - FIP rule	78.7	0.0	731,892	0
	Point Sources	RE Improvements	7,755.6	0.0	15,511,040	0
	Recreational vehicles	CARB standards	309.4	0.0	164,007	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	251.7	0.0	6,290	0
	Wood furniture surface coating	Reformulation	4.3	0.0	6,116	0
	Wood product surface coating	Reformulation	1.3	0.0	83	0
		Total	12,393.9	3,214.3	33,735,538	2,029,332
Beaumont, TX	Metal product surface coating	VOC content limits & improved	43.3	0.0	1,746	0
	Open Burning	Episodic Ban	313.4	59.3	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	22.6	0.0	0	0
	Point Sources	RE Improvements	96,693.2	0.0	193,386,49 0	0
	Recreational vehicles	CARB standards	69.9	0.0	36,998	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	220.0	0.0	5,502	0

Table B-5 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Wood furniture surface coating	Reformulation	6.7	0.0	9,574	0
		Total	97,369.1	59.3	193,440,310	0
Boston, MA	Area Source Industrial NG Comb	RACT to small sources	0.0	133.3	0	200,842
	Area Source Industrial Oil Comb	RACT to small sources	0.0	5.6	0	11,097
	Commercial Marine Vessels	Emission Fees	0.0	424.5	0	4,244,709
	Gas Turbines - Natural Gas	SCR + STEAM INJECTION	0.0	0.2	0	84,232
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	49.6	0	890,285
	Glass Manufacturing - Container	LNB	0.0	73.9	0	177,254
	Glass Manufacturing - Container	Oxy-Firing	0.0	18.5	0	613,928
	Glass Manufacturing - Container	SCR	0.0	64.6	0	248,572
	IC Engines - Natural Gas	NSCR	0.0	71.3	0	302,388
	IC Engines - Oil	SCR	0.0	534.7	0	4,958,122
	Industrial Boiler - Distillate Oi	LNB + FGR	0.0	44.8	0	459,376
	Industrial Boiler - Distillate Oi	SCR	0.0	89.7	0	980,373
	Industrial Boiler - Natural Gas	LNB + FGR	0.0	127.3	0	809,325
	Industrial Boiler - Natural Gas	SCR	0.0	254.3	0	2,394,636
	Industrial Boiler - Other	LNB + FGR	0.0	6.0	0	61,664
	Industrial Boiler - Other	SCR	0.0	12.1	0	131,600
	Industrial Boiler - PC	SCR	0.0	0.9	0	25,225
	Industrial Boiler - PC	SNCR	0.0	0.6	0	8,120
	Industrial Boiler - Residual Oil	LNB + FGR	0.0	457.9	0	2,622,125
	Industrial Boiler - Residual Oil	SCR	0.0	916.0	0	6,824,419
	Industrial Boiler - Stoker	SCR	0.0	12.7	0	132,610
	Industrial Cogeneration - Nat. Ga	LNB	0.0	48.9	0	47,086
	Industrial Cogeneration - Nat. Ga	LNB + FGR	0.0	9.8	0	62,250
	Industrial Cogeneration - Nat. Ga	SCR	0.0	19.6	0	184,184
	Motor Vehicles	California LEV	14,684.3	26,387.2	19,020,590	19,020,590
	Motor Vehicles	California Reform	2,780.2	6,380.1	0	99,666,930
	Motor Vehicles	Reform Diesel	0.0	1,228.5	0	17,919,520
	Municipal Waste Combustors	SNCR	0.0	43.4	0	145,140
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	351.4	0	2,867,255
	Nonroad gasoline	Reformulated gasoline	557.7	0.0	2,788,500	0
	Open Burning	Episodic Ban	1,857.4	352.5	0	0
	Process Heaters - Natural Gas	LNB + SCR	0.0	0.0	0	304
	Residential NG Consumption	LNB Space heaters	0.0	1,246.1	0	2,008,262
	Residential NG Consumption	Water heater replacement	0.0	386.3	0	0
	Utility Boiler - Cyclone	SCR	0.0	4,557.9	0	56,188,822
	Utility Boiler - Oil-Gas/Tangenti	LNB + FGR + OFA	0.0	1,940.5	0	7,706,715
	Utility Boiler - Oil-Gas/Tangenti	SCR	0.0	2,013.1	0	20,158,378
	Utility Boiler - Oil-Gas/Wall	LNB + FGR + OFA	0.0	31.4	0	1,136,476
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	7,237.8	0	42,291,603
	Utility Boiler - PC/Wall	SCR	0.0	970.0	0	9,713,098
		Total	19,879.6	56,503.0	21,809,090	305,297,515
Houston, TX	Aerosols	CARB Tier 2 Standards - Reform	561.0	0.0	1,402,674	0

Table B-5 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Aerosols	SCAQMD Standards - Reformulati	561.0	0.0	5,610,696	0
	Automobile refinishing	CARB BARCT limits	143.2	0.0	526,510	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	546.6	0.0	9,849,515	0
	marine surface coating	Add-on control levels	116.2	0.0	1,684,017	0
	Metal product surface coating	VOC content limits & improved	1,420.1	0.0	46,340	0
	Miscellaneous surface coating	Add-on control levels	68.0	0.0	3,978,067	0
	Miscellaneous surface coating	MACT level of control	603.5	0.0	1,508,563	0
	Motor Vehicles	California LEV	9,647.9	17,306.0	13,788,716	13,788,716
	Nonroad gasoline	Reformulated gasoline	450.1	0.0	2,250,500	0
	Open Burning	Episodic Ban	1,959.8	372.0	0	0
	Paper surface coating	Add-on control levels	23.3	0.0	2,415,926	0
	Pesticide Application	Reformulation - FIP rule	129.5	0.0	1,202,956	0
	Point Source Ind. Surface Coating	Add-on Control Levels	4.4	0.0	80,592	0
	Point Source Metal Surface Coating	FIP VOC Limits	123.4	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	92.7	0.0	2,318	0
	Point Sources	RE Improvements	196,046.7	0.0	392,093,220	0
	Recreational vehicles	CARB standards	715.4	0.0	379,063	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,973.8	0.0	49,366	0
	Wood furniture surface coating	Reformulation	126.3	0.0	180,870	0
	Wood product surface coating	Reformulation	6.4	0.0	272	0
		Total	215,319.3	17,678.0	437,050,181	13,788,716
Los Angeles, CA	Aerosols	SCAQMD Standards - Reformulati	3,864.6	0.0	0	24,153,420
	Aircraft surface coating	Add-on control levels	50.2	0.0	0	1,580,530
	Automobile refinishing	FIP Rule (VOC Content & TE)	6,106.4	0.0	0	91,869,474
	marine surface coating	Add-on control levels	105.7	0.0	0	1,529,243
	Metal product surface coating	VOC content limits & improved	2,019.0	0.0	0	50,468
	Miscellaneous surface coating	Add-on control levels	1,712.7	0.0	0	65,695,922
	Miscellaneous surface coating	MACT level of control	1,786.9	0.0	0	4,467,268
	Nonroad gasoline	Reformulated gasoline	1,159.7	0.0	0	5,798,500
	Open Burning	Episodic Ban	5,012.4	952.0	0	0
	Paper surface coating	Add-on control levels	34.8	0.0	0	2,278,878
	Pesticide Application	Reformulation - FIP rule	140.0	0.0	0	1,301,442
	Point Source Ind. Surface Coating	Add-on Control Levels	3,073.1	0.0	0	56,542,004
	Point Source Metal Surface Coating	FIP VOC Limits	1,426.4	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	4,533.3	0.0	0	113,332
	Point Sources	RE Improvements	3,232.8	0.0	0	6,465,610
	Recreational vehicles	CARB standards	257.8	0.0	0	136,567
	Service stations - stage I-truck un	Vapor balance & P-V valves	5,983.2	0.0	0	149,578
	Wood furniture surface coating	Reformulation	3,574.1	0.0	0	3,554,033

Table B-5 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
	Wood product surface coating	Reformulation	46.6	0.0	0	1,164
		Total	44,119.7	952.0	0	265,687,43 3
New London, CT	Aerosols	CARB Tier 2 Standards - Reform	44.0	0.0	109,962	0
	Aerosols	SCAQMD Standards - Reformulati	44.0	0.0	439,848	0
	Aircraft surface coating	Add-on control levels	3.7	0.0	195,702	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	31.0	0.0	901,542	0
	Metal product surface coating	VOC content limits & improved	31.8	0.0	4,270	0
	Miscellaneous surface coating	Add-on control levels	11.4	0.0	688,680	0
	Motor Vehicles	California LEV	726.1	1,455.2	1,115,752	1,115,752
	Motor Vehicles	California Reform	180.6	403.7	0	5,886,687
	Nonroad gasoline	Reformulated gasoline	50.2	0.0	251,000	0
	Open Burning	Episodic Ban	87.2	16.6	0	0
	Paper surface coating	Add-on control levels	11.5	0.0	1,149,765	0
	Pesticide Application	Reformulation - FIP rule	6.9	0.0	63,556	0
	Point Source Ind. Surface Coating	Add-on Control Levels	43.4	0.0	799,204	0
	Point Sources	RE Improvements	671.2	0.0	1,342,470	0
	Recreational vehicles	CARB standards	152.7	0.0	80,892	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	141.1	0.0	3,529	0
	Wood furniture surface coating	Reformulation	34.3	0.0	54,834	0
		Total	2,271.1	1,875.5	7,201,006	7,002,439
New York, NY	Aerosols	CARB Tier 2 Standards - Reform	2,547.7	0.0	6,368,928	0
	Aerosols	SCAQMD Standards - Reformulati	2,547.9	0.0	25,475,712	0
	Aircraft surface coating	Add-on control levels	72.3	0.0	2,406,278	0
	Automobile refinishing	CARB BARCT limits	1,331.7	0.0	4,898,113	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	5,440.1	0.0	102,002,01 5	0
	marine surface coating	Add-on control levels	113.2	0.0	1,942,544	0
	Metal product surface coating	VOC content limits & improved	1,601.4	0.0	169,351	0
	Miscellaneous surface coating	Add-on control levels	1,290.7	0.0	61,726,005	0
	Miscellaneous surface coating	MACT level of control	17.7	0.0	44,158	0
	Motor Vehicles	California LEV	35,237.4	59,342. 2	44,652,472	44,652,472
	Motor Vehicles	California Reform	6,942.1	14,622. 0	0	233,306,89 9
	Motor Vehicles	Enhanced I/M	120.4	120.4	44,994	89,989
	Motor Vehicles	Federal Reform	99.2	24.8	407,733	0
	Nonroad gasoline	Reformulated gasoline	1,076.5	0.0	5,382,500	0
	Open Burning	Episodic Ban	10,288.5	1,952.1		0
	Paper surface coating	Add-on control levels	215.6	0.0	18,252,178	0
	Pesticide Application	Reformulation - FIP rule	75.7	0.0	701,948	0
	Point Source Ind. Surface Coating	Add-on Control Levels	674.6	0.0	12,411,168	0
	Point Source Metal Surface Coating	FIP VOC Limits	362.1	0.0	0	0

Table B-5 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Point Source Wood Product Coating	FIP VOC Limits	308.1	0.0	7,702	0
	Point Sources	RE Improvements	34,426.8	0.0	68,853,600	0
	Recreational vehicles	CARB standards	2,026.1	0.0	1,073,735	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	5,918.0	0.0	147,982	0
	Wood furniture surface coating	Reformulation	2,329.0	0.0	2,516,746	0
	Wood product surface coating	Reformulation	41.5	0.0	2,222	0
		Total	115,104.3	76,061.5	359,488,084	278,049,360
Philadelphia, PA	Aerosols	CARB Tier 2 Standards - Reform	845.9	0.0	2,115,240	0
	Aerosols	SCAQMD Standards - Reformulati	846.0	0.0	8,460,960	0
	Aircraft surface coating	Add-on control levels	28.0	0.0	1,012,040	0
	Automobile refinishing	CARB BARCT limits	538.4	0.0	1,979,953	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	2,055.3	0.0	37,039,187	0
	marine surface coating	Add-on control levels	169.3	0.0	3,133,282	0
	Metal product surface coating	VOC content limits & improved	660.6	0.0	23,139	0
	Miscellaneous surface coating	Add-on control levels	363.9	0.0	18,947,807	0
	Miscellaneous surface coating	MACT level of control	49.0	0.0	122,400	0
	Motor Vehicles	California LEV	12,095.2	19,957.8	15,736,303	15,736,303
	Motor Vehicles	California Reform	2,614.0	5,331.8	0	82,411,343
	Nonroad gasoline	Reformulated gasoline	518.2	0.0	2,591,000	0
	Open Burning	Episodic Ban	2,617.5	496.4	0	0
	Paper surface coating	Add-on control levels	65.0	0.0	4,729,047	0
	Pesticide Application	Reformulation - FIP rule	124.4	0.0	1,156,270	0
	Point Source Ind. Surface Coating	Add-on Control Levels	5,049.4	0.0	92,909,144	0
	Point Source Metal Surface Coating	FIP VOC Limits	339.2	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	97.1	0.0	2,427	0
	Point Sources	RE Improvements	30,515.8	0.0	61,031,650	0
	Recreational vehicles	CARB standards	801.1	0.0	424,358	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	2,221.4	0.0	55,538	0
	Wood furniture surface coating	Reformulation	820.4	0.0	859,129	0
	Wood product surface coating	Reformulation	13.5	0.0	491	0
		Total	63,448.6	25,786.0	252,329,365	98,147,646
San Diego, CA	Aerosols	CARB Tier 2 Standards - Reform	325.4	0.0	813,420	0
	Aerosols	SCAQMD Standards - Reformulati	325.4	0.0	3,253,680	0
	Automobile refinishing	CARB BARCT limits	186.4	0.0	685,506	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	711.6	0.0	12,823,854	0
	Metal product surface coating	VOC content limits & improved	241.3	0.0	6,032	0
	Miscellaneous surface coating	Add-on control levels	179.2	0.0	4,992,999	0
	Miscellaneous surface coating	MACT level of control	396.7	0.0	991,706	0

Table B-5 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Nonroad gasoline	Reformulated gasoline	240.9	0.0	1,204,500	0
	Open Burning	Episodic Ban	679.7	129.1	0	0
	Paper surface coating	Add-on control levels	2.8	0.0	184,069	0
	Pesticide Application	Reformulation - FIP rule	20.4	0.0	189,534	0
	Point Source Ind. Surface Coating	Add-on Control Levels	936.2	0.0	17,226,540	0
	Point Sources	RE Improvements	362.4	0.0	724,890	0
	Recreational vehicles	CARB standards	885.1	0.0	469,092	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	980.6	0.0	24,516	0
	Wood furniture surface coating	Reformulation	734.4	0.0	275,388	0
	Wood product surface coating	Reformulation	6.8	0.0	170	0
		Total	7,215.3	129.1	43,865,896	0

Table B-6 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Municipal Waste Combustors	SNCR	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Motor Vehicles	California LEV	0.0	0.0	0	0
	Motor Vehicles	Reform Diesel	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Cincinnati, OH	Open Burning	Episodic Ban	2,072.1	394.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	155.1	0.0	2,854,300	0
	Point Source Metal Surface Coating	FIP VOC Limits	455.9	0.0	0	0
	Point Sources	RE Improvements	857.1	0.0	1,714,040	0
	Bulk Terminals	RACT	151.5	0.0	252,353	0
	Metal product surface coating	VOC content limits & improved	239.9	0.0	7,037	0
	Wood product surface coating	Reformulation	9.1	0.0	254	0
	Wood furniture surface coating	Reformulation	746.9	0.0	315,871	0
	Adhesives - industrial	RACT	112.3	0.0	280,881	0
	Paper surface coating	Add-on control levels	43.5	0.0	3,044,887	0
	Miscellaneous surface coating	Add-on control levels	338.3	0.0	12,751,156	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	492.1	0.0	7,406,063	0
	Miscellaneous surface coating	MACT level of control	43.5	0.0	108,727	0
	Aerosols	SCAQMD Standards - Reformulati	565.1	0.0	3,532,770	0
	Aircraft surface coating	Add-on control levels	51.8	0.0	1,873,198	0
	marine surface coating	Add-on control levels	9.9	0.0	143,004	0
	Cutback Asphalt	Switch to emulsified asphalts	139.3	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	921.4	0.0	158,426	0
	Web Offset Lithography	New CTG (carbon adsorber)	9.6	0.0	-1,187	0
	Pesticide Application	Reformulation - FIP rule	130.7	0.0	1,213,893	0
	Recreational vehicles	CARB standards	212.6	0.0	112,612	0
	Motor Vehicles	California Reform	10,111.3	3,905.1	29,324,120	32,364,736
	Motor Vehicles	Enhanced I/M	11,801.5	8,822.8	872,858	1,745,717
	Motor Vehicles	California LEV	4,328.1	7,902.2	6,168,250	6,168,250
		Total	33,998.6	21,024.1	72,133,513	40,278,702
Fresno, CA	Adhesives - industrial	RACT	1.3	0.0	3,276	0
	Aerosols	CARB Tier 2 Standards - Reform	100.5	0.0	251,094	0
	Aerosols	SCAQMD Standards - Reformulati	100.5	0.0	1,004,376	0
	Automobile refinishing	CARB BARCT limits	51.8	0.0	190,706	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	198.0	0.0	3,567,537	0
	Bulk Terminals	RACT	21.8	0.0	36,371	0
	Cutback Asphalt	Switch to emulsified asphalts	14.0	0.0	0	0
	marine surface coating	Add-on control levels	11.1	0.0	160,048	0
	Metal product surface coating	VOC content limits & improved	67.4	0.0	1,680	0
	Miscellaneous surface coating	Add-on control levels	83.5	0.0	1,305,006	0
	Miscellaneous surface coating	MACT level of control	24.1	0.0	60,127	0
	Motor Vehicles	Enhanced I/M	194.8	329.3	77,881	155,763
	Nonroad gasoline	Reformulated gasoline	53.6	0.0	268,000	0
	Open Burning	Episodic Ban	230.7	43.8	0	0

Table B-6 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Paper surface coating	Add-on control levels	4.0	0.0	267,273	0
	Pesticide Application	Reformulation - FIP rule	530.9	0.0	4,937,073	0
	Point Source Metal Surface Coating	FIP VOC Limits	52.6	0.0	0	0
	Point Sources	RE Improvements	3,512.0	0.0	7,024,060	0
	Recreational vehicles	CARB standards	51.9	0.0	27,517	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	339.5	0.0	41,403	0
	Wood furniture surface coating	Reformulation	93.1	0.0	34,896	0
	Wood product surface coating	Reformulation	2.5	0.0	62	0
		Total	5,739.6	373.1	19,258,386	155,763
Grand Rapids, MI	Open Burning	Episodic Ban	838.2	158.8	0	0
	Point Sources	RE Improvements	6,025.1	0.0	12,050,110	0
	Metal product surface coating	VOC content limits & improved	199.1	0.0	4,981	0
	Wood product surface coating	Reformulation	6.5	0.0	298	0
	Wood furniture surface coating	Reformulation	5,374.7	0.0	2,015,519	0
	Adhesives - industrial	RACT	130.6	0.0	326,390	0
	Miscellaneous surface coating	Add-on control levels	1,465.0	0.0	34,136,134	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	357.1	0.0	5,372,689	0
	Aerosols	SCAQMD Standards - Reformulati	249.4	0.0	1,558,560	0
	marine surface coating	Add-on control levels	68.1	0.0	985,510	0
	Cutback Asphalt	Switch to emulsified asphalts	85.3	0.0	0	0
	Pharmaceutical manufacture	RACT	138.2	0.0	46,285	0
	Oiland natural gas production fiel	RACT (equipment/maintenance)	37.2	0.0	14,770	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	355.9	0.0	8,899	0
	Web Offset Lithography	New CTG (carbon adsorber)	8.5	0.0	-1,067	0
	Pesticide Application	Reformulation - FIP rule	81.1	0.0	753,356	0
	Recreational vehicles	CARB standards	660.0	0.0	349,778	0
	Motor Vehicles	California Reform	5,771.8	2,152.6	17,444,686	16,125,166
	Motor Vehicles	Enhanced I/M	5,589.0	4,425.7	456,892	913,783
	Motor Vehicles	California LEV	2,132.3	3,930.0	3,060,281	3,060,281
		Total	29,573.1	10,667.1	78,584,070	20,099,230
Hartford, CT	Open Burning	Episodic Ban	890.4	168.9	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	5.8	0.0	107,456	0
	Point Source Metal Surface Coating	FIP VOC Limits	102.9	0.0	0	0
	Metal product surface coating	VOC content limits & improved	90.3	0.0	12,139	0
	Wood product surface coating	Reformulation	4.7	0.0	116	0
	Wood furniture surface coating	Reformulation	46.7	0.0	74,532	0
	Paper surface coating	Add-on control levels	13.7	0.0	1,374,240	0
	Miscellaneous surface coating	Add-on control levels	43.6	0.0	3,164,929	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	269.8	0.0	7,859,989	0
	Aerosols	SCAQMD Standards - Reformulati	276.6	0.0	1,728,300	0
	Aircraft surface coating	Add-on control levels	115.6	0.0	6,053,206	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	467.5	0.0	11,687	0

Table B-6 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Pesticide Application	Reformulation - FIP rule	12.5	0.0	115,841	0
	Recreational vehicles	CARB standards	296.1	0.0	156,879	0
	Motor Vehicles	California Reform	710.1	1,313.5	486,500	19,984,065
	Motor Vehicles	California LEV	2,649.3	4,889.5	3,811,174	3,811,174
		Total	5,995.6	6,371.9	24,956,988	23,795,239
Houston, TX	Open Burning	Episodic Ban	73.7	13.8	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	85.0	0.0	1,564,828	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	62.8	0.0	1,570	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Bulk Terminals	RACT	203.7	0.0	339,507	0
	Metal product surface coating	VOC content limits & improved	5.1	0.0	129	0
	Wood product surface coating	Reformulation	1.5	0.0	38	0
	Wood furniture surface coating	Reformulation	12.1	0.0	4,536	0
	Adhesives - industrial	RACT	27.2	0.0	68,115	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	2.6	0.0	46,902	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	13.3	0.0	200,944	0
	Miscellaneous surface coating	MACT level of control	2.2	0.0	5,479	0
	Aerosols	SCAQMD Standards - Reformulati	35.7	0.0	223,770	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Cutback Asphalt	Switch to emulsified asphalts	112.6	0.0	0	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	11.8	0.0	4,674	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	260.9	0.0	195,467	0
	Web Offset Lithography	New CTG (carbon adsorber)	10.5	0.0	-1,319	0
	Pesticide Application	Reformulation - FIP rule	105.6	0.0	981,616	0
	Recreational vehicles	CARB standards	21.5	0.0	11,363	0
	Motor Vehicles	Federal Reform	1,537.0	173.5	4,941,337	0
	Motor Vehicles	Enhanced I/M	888.9	750.5	291,551	583,103
	Motor Vehicles	California LEV	279.7	633.8	471,922	471,922
		Total	3,753.4	1,571.6	9,352,429	1,055,025
Los Angeles, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0

Table B-6 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Macon, GA	Utility Boiler - PC/Wall	SCR	0.0	28,812.3	0	98,504,407
	Industrial Boiler - PC	SCR	0.0	408.0	0	3,211,810
	Industrial Boiler - Stoker	SCR	0.0	160.3	0	723,909
	Industrial Boiler - Residual Oil	SCR	0.0	35.1	0	89,951
	Industrial Boiler - Distillate Oil	SCR	0.0	3.6	0	14,401
	Industrial Boiler - Natural Gas	SCR	0.0	824.0	0	2,947,503
	Area Source Industrial NG Comb	RACT to small sources	0.0	40.8	0	70,340
	Open Burning	Episodic Ban	624.9	118.6	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	38.4	0	313,798
	Glass Manufacturing - Container	Oxy-Firing	0.0	42.5	0	266,848
	Cement Manufacturing - Dry	SCR	0.0	493.1	0	2,359,895
	Cement Manufacturing - Wet	SCR	0.0	419.6	0	1,675,408
	Motor Vehicles	California Reform	3,022.7	995.0	7,928,050	7,436,718
	Motor Vehicles	Enhanced I/M	2,705.8	2,127.9	872,699	1,745,399
	Motor Vehicles	California LEV	1,023.5	1,819.7	1,412,305	1,412,305
	Motor Vehicles	Reform Diesel	0.0	113.2	0	1,623,901
		Total	7,376.9	36,452.1	10,213,054	122,396,593
Nashville, TN	Utility Boiler - PC/Tangential	SCR	0.0	10,608.4	0	38,924,513
	Industrial Boiler - PC	SCR	0.0	224.4	0	4,796,549
	Industrial Boiler - Stoker	SCR	0.0	39.7	0	413,030
	Industrial Boiler - Residual Oil	SCR	0.0	5.2	0	35,640
	Industrial Boiler - Distillate Oil	SCR	0.0	19.8	0	213,310
	Industrial Boiler - Natural Gas	SCR	0.0	225.7	0	1,841,638
	IC Engines - Natural Gas	NSCR	0.0	1,474.8	0	1,313,705
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	246.5	0	5,652,452
	Process Heaters - Natural Gas	LNB + SCR	0.0	11.3	0	174,243
	Area Source Industrial Coal Comb	RACT to small sources	0.0	27.7	0	107,750
	Open Burning	Episodic Ban	746.4	141.4	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	104.6	0	852,643
	Commercial Marine Vessels	Emission Fees	0.0	27.6	0	274,516
	Municipal Waste Combustors	SNCR	0.0	131.6	0	439,269
	Motor Vehicles	California Reform	6,233.1	2,567.0	21,478,978	20,150,267
	Motor Vehicles	Enhanced I/M	6,669.3	5,484.2	567,807	1,135,613
	Motor Vehicles	California LEV	2,738.0	4,903.5	3,839,754	3,839,754
	Motor Vehicles	Reform Diesel	0.0	265.6	0	3,869,653

Table B-6 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
		Total	16,386.8	26,509.0	25,886,538	84,034,545
New London, CT	Open Burning	Episodic Ban	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.9	0.0	22	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Motor Vehicles	California LEV	0.0	0.0	0	0
		Total	0.9	0.0	22	0
New York, NY	Open Burning	Episodic Ban	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Motor Vehicles	Enhanced I/M	0.0	0.0	0	0
	Motor Vehicles	California LEV	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Owensboro, KY	Utility Boiler - PC/Wall	SCR	0.0	4,635.5	0	21,299,059
	Utility Boiler - PC/Tangential	SCR	0.0	1,944.4	0	7,109,311
	Area Source Industrial Coal Comb	RACT to small sources	0.0	94.6	0	354,725

Table B-6 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Area Source Industrial Oil Comb	RACT to small sources	0.0	8.8	0	18,458
	Area Source Industrial NG Comb	RACT to small sources	0.0	172.4	0	272,704
	Open Burning	Episodic Ban	168.3	31.9	0	0
	Motor Vehicles	Federal Reform	548.9	113.3	1,709,186	0
	Motor Vehicles	Enhanced I/M	740.2	470.9	191,738	383,477
		Total	1,457.4	7,471.8	1,900,924	29,437,734
Philadelphia, PA	Open Burning	Episodic Ban	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Motor Vehicles	California LEV	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Providence, RI	Open Burning	Episodic Ban	560.1	106.4	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	177.8	0.0	3,270,692	0
	Point Source Metal Surface Coating	FIP VOC Limits	129.6	0.0	0	0
	Point Sources	RE Improvements	2,381.3	0.0	4,762,520	0
	Metal product surface coating	VOC content limits & improved	481.8	0.0	11,958	0
	Wood product surface coating	Reformulation	5.6	0.0	141	0
	Wood furniture surface coating	Reformulation	403.0	0.0	151,099	0
	Paper surface coating	Add-on control levels	3.3	0.0	220,089	0
	Miscellaneous surface coating	Add-on control levels	195.0	0.0	3,156,486	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	434.2	0.0	6,533,259	0
	Miscellaneous surface coating	MACT level of control	148.9	0.0	372,146	0
	Aerosols	SCAQMD Standards - Reformulati	296.8	0.0	1,854,330	0
	marine surface coating	Add-on control levels	134.5	0.0	1,946,944	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	356.5	0.0	8,909	0
	Pesticide Application	Reformulation - FIP rule	2.8	0.0	26,709	0

Table B-6 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Recreational vehicles	CARB standards	789.7	0.0	418,473	0
	Motor Vehicles	California Reform	590.1	1,002.0	737,000	15,574,996
	Motor Vehicles	California LEV	2,302.1	3,756.5	2,980,279	2,980,279
		Total	9,393.1	4,864.9	26,451,034	18,555,275
Sacramento, CA	Aerosols	CARB Tier 2 Standards - Reform	190.8	0.0	476,892	0
	Aerosols	SCAQMD Standards - Reformulati	190.7	0.0	1,907,568	0
	Automobile refinishing	CARB BARCT limits	123.8	0.0	455,517	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	472.8	0.0	8,521,420	0
	marine surface coating	Add-on control levels	4.2	0.0	60,687	0
	Metal product surface coating	VOC content limits & improved	228.4	0.0	5,663	0
	Miscellaneous surface coating	Add-on control levels	116.6	0.0	1,886,434	0
	Miscellaneous surface coating	MACT level of control	91.7	0.0	229,219	0
	Nonroad gasoline	Reformulated gasoline	101.3	0.0	506,500	0
	Open Burning	Episodic Ban	429.8	81.3	0	0
	Paper surface coating	Add-on control levels	3.1	0.0	206,239	0
	Pesticide Application	Reformulation - FIP rule	113.8	0.0	1,058,898	0
	Point Source Ind. Surface Coating	Add-on Control Levels	361.7	0.0	6,655,556	0
	Point Source Metal Surface Coating	FIP VOC Limits	313.9	0.0	0	0
	Point Sources	RE Improvements	40.5	0.0	81,030	0
	Recreational vehicles	CARB standards	97.3	0.0	51,601	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	646.7	0.0	16,167	0
	Wood furniture surface coating	Reformulation	240.2	0.0	90,098	0
	Wood product surface coating	Reformulation	16.0	0.0	399	0
		Total	3,783.3	81.3	22,209,888	0
San Diego, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0

Table B-6 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
Springfield, MA	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	256.4	0	6,961,478
	Industrial Boiler - PC	SCR	0.0	44.3	0	948,195
	Industrial Boiler - Stoker	SCR	0.0	108.2	0	1,127,084
	Industrial Boiler - Residual Oil	SCR	0.0	141.9	0	976,271
	Industrial Boiler - Natural Gas	SCR	0.0	159.9	0	1,342,660
	IC Engines - Natural Gas	NSCR	0.0	58.5	0	179,810
	Gas Turbines - Natural Gas	SCR + STEAM INJECTION	0.0	106.6	0	511,328
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	146.7	0	731,902
	Residential NG Consumption	LNB Space heaters	0.0	531.5	0	653,642
	Open Burning	Episodic Ban	2,129.9	404.0	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	33.8	0	275,292
	Commercial Marine Vessels	Emission Fees	0.0	252.3	0	2,523,158
	Motor Vehicles	California Reform	398.0	672.7	467,000	10,679,254
	Motor Vehicles	California LEV	1,714.3	2,857.2	2,038,322	2,038,322
	Motor Vehicles	Reform Diesel	0.0	134.5	0	1,911,328
		Total	4,242.2	5,908.5	2,505,322	30,859,724
Washington, DC	Utility Boiler - PC/Wall	SCR	0.0	28,076.6	0	86,025,342
	Utility Boiler - PC/Tangential	SCR	0.0	25,456.0	0	101,567,747
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	5,738.6	0	52,216,489
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	3,364.4	0	41,194,478
	Utility Boiler - Cyclone	SCR	0.0	2,833.2	0	33,909,713
	Industrial Boiler - PC	SCR	0.0	3,950.8	0	31,280,313
	Industrial Boiler - Stoker	SCR	0.0	111.5	0	1,161,708
	Industrial Boiler - Residual Oil	SCR	0.0	713.4	0	4,674,888
	Industrial Boiler - Distillate Oil	SCR	0.0	107.4	0	1,126,417
	Industrial Boiler - Natural Gas	SCR	0.0	936.8	0	7,865,392
	IC Engines - Oil	SCR	0.0	362.2	0	1,968,033
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	48.8	0	2,592,825
	Process Heaters - Natural Gas	LNB + SCR	0.0	6.3	0	183,156
	Area Source Industrial Coal Comb	RACT to small sources	0.0	29.7	0	118,154
	Area Source Industrial Oil Comb	RACT to small sources	0.0	13.1	0	20,421
	Area Source Industrial NG Comb	RACT to small sources	0.0	45.6	0	65,735
	Residential NG Consumption	LNB Space heaters	0.0	2,607.8	0	3,207,326
	Open Burning	Episodic Ban	911.4	173.4	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	486.9	0	3,972,107
	Commercial Marine Vessels	Emission Fees	0.0	536.0	0	5,358,057
	Industrial Boiler - Other	SCR	0.0	15.8	0	169,106
	Glass Manufacturing - Container	Oxy-Firing	0.0	59.9	0	396,919
	Cement Manufacturing - Dry	SCR	0.0	2,187.8	0	11,048,592
	Cement Manufacturing - Wet	SCR	0.0	808.4	0	3,405,438
	Iron & Steel Mills - Reheating	LNB + FGR	0.0	444.8	0	233,562
	Iron & Steel Mills - Annealing	LNB + SCR	0.0	70.3	0	360,338
	Municipal Waste Combustors	SNCR	0.0	140.2	0	467,984
	Point Source Ind. Surface Coating	Add-on Control Levels	353.0	0.0	6,494,372	0
	Point Source Metal Surface Coating	FIP VOC Limits	824.2	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	7.3	0.0	183	0

Table B-6 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
	Point Sources	RE Improvements	5,634.0	0.0	11,268,280	0
	Bulk Terminals	RACT	833.1	0.0	1,388,281	0
	Metal product surface coating	VOC content limits & improved	645.8	0.0	28,410	0
	Wood product surface coating	Reformulation	26.9	0.0	810	0
	Wood furniture surface coating	Reformulation	1,229.7	0.0	469,264	0
	Adhesives - industrial	RACT	176.5	0.0	441,529	0
	Paper surface coating	Add-on control levels	83.3	0.0	3,404,679	0
	Miscellaneous surface coating	Add-on control levels	455.2	0.0	8,406,296	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	2,273.6	0.0	34,205,397	0
	Miscellaneous surface coating	MACT level of control	129.3	0.0	323,092	0
	Aerosols	SCAQMD Standards - Reformulati	1,895.6	0.0	11,844,990	0
	Aircraft surface coating	Add-on control levels	21.9	0.0	787,137	0
	marine surface coating	Add-on control levels	105.4	0.0	1,522,900	0
	Cutback Asphalt	Switch to emulsified asphalts	234.1	0.0	0	0
	Synthetic fiber manufacture	RACT (adsorber)	1,408.2	0.0	1,991,973	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	3,690.7	0.0	604,238	0
	Web Offset Lithography	New CTG (carbon adsorber)	38.2	0.0	-4,787	0
	Pesticide Application	Reformulation - FIP rule	233.8	0.0	2,173,301	0
	Recreational vehicles	CARB standards	838.9	0.0	444,536	0
	Motor Vehicles	Federal Reform	2,980.7	580.8	12,457,815	0
	Motor Vehicles	Enhanced I/M	2,309.2	2,294.4	881,214	1,762,429
	Motor Vehicles	California LEV	15,654.8	28,610.7	22,493,022	22,493,022
	Motor Vehicles	Reform Diesel	0.0	1,483.5	0	21,669,143
		Total	42,994.8	112,295.1	121,626,932	440,514,833

Table B-7. Alternative 8H4AX-80: Marginal Emission Reductions and Costs by Nonattainment Area and Control Measure Under the LCS

			Reductions (tons per year)		Costs (1990$)	
Nonattainment Area	Source Category	Control Measure	VOC	NOx	VOC	NOx
Athens, GA	Industrial Boiler - Stoker	SNCR	0.0	3.7	0	7,766
	Industrial Boiler - Residual Oil	SCR	0.0	8.7	0	22,258
	Industrial Boiler - Distillate Oil	LNB	0.0	2.7	0	3,765
	Industrial Boiler - Natural Gas	SCR	0.0	205.6	0	730,049
	Area Source Industrial NG Comb	RACT to small sources	0.0	14.6	0	24,646
	Open Burning	Episodic Ban	183.4	34.7	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	16.4	0	133,422
	Motor Vehicles	California Reform	1,274.9	474.4	3,602,027	3,381,626
	Motor Vehicles	Enhanced I/M	1,140.5	991.4	394,978	789,956
	Motor Vehicles	California LEV	425.0	842.6	639,267	639,267
	Motor Vehicles	Reform Diesel	0.0	56.7	0	861,901
		Total	3,023.8	2,651.5	4,636,272	6,594,656
Atlanta, GA	Utility Boiler - PC/Wall	SCR	0.0	26,524.7	0	88,115,238
	Utility Boiler - PC/Tangential	SCR	0.0	48,973.9	0	169,190,588
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	1,311.5	0	9,837,161
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	5.2	0	2,423,615
	Industrial Boiler - PC	SCR	0.0	1,594.6	0	15,090,051
	Industrial Boiler - Stoker	SCR	0.0	41.5	0	186,329
	Industrial Boiler - Residual Oil	SCR	0.0	755.8	0	2,241,934
	Industrial Boiler - Distillate Oil	SCR	0.0	23.0	0	130,734
	Industrial Boiler - Natural Gas	SCR	0.0	662.9	0	2,674,891
	Area Source Industrial NG Comb	RACT to small sources	0.0	62.2	0	107,109
	Open Burning	Episodic Ban	2,417.3	458.5	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	334.7	0	2,729,478
	Glass Manufacturing - Container	Oxy-Firing	0.0	720.8	0	4,774,851
	Cement Manufacturing - Dry	SCR	0.0	451.5	0	2,279,852
	Motor Vehicles	California Reform	13,454.9	8,667.4	82,160,287	77,361,722
	Motor Vehicles	Enhanced I/M	3,421.6	3,126.3	1,224,295	2,448,590
	Motor Vehicles	California LEV	10,540.4	18,750.8	14,761,639	14,761,639
	Motor Vehicles	Reform Diesel	0.0	977.2	0	14,231,310
		Total	29,834.2	113,442.5	98,146,221	408,585,092
Bakersfield, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	1.1	0.0	76,493	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.7	0.0	16	0
		Total	1.8	0.0	76,509	0
Bangor, ME	Utility Boiler - Oil-Gas/Wall	SCR	0.0	17.5	0	115,439
	Industrial Boiler - Residual Oil	SCR	0.0	959.5	0	6,597,030
	Area Source Industrial Oil Comb	RACT to small sources	0.0	5.1	0	10,356
	Area Source Industrial NG Comb	RACT to small sources	0.0	1.9	0	2,766
	Open Burning	Episodic Ban	453.0	85.9	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	2.7	0	21,307
	Commercial Marine Vessels	Emission Fees	0.0	8.5	0	85,048
	Motor Vehicles	California Reform	907.7	573.6	3,170,613	5,481,359
	Motor Vehicles	Enhanced I/M	1,671.7	1,380.8	550,911	1,101,822
	Motor Vehicles	California LEV	648.1	1,359.5	1,031,460	1,031,460
	Motor Vehicles	Reform Diesel	0.0	102.7	0	1,586,852
		Total	3,680.5	4,497.7	4,752,984	16,033,439
Baton Rouge, LA	Open Burning	Episodic Ban	-19.0	-3.7	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.4	0.0	20	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Adhesives - industrial	RACT	3.0	0.0	7,459	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	-1.4	0.0	-21,243	0
	Miscellaneous surface coating	MACT level of control	2.1	0.0	5,299	0
	Aerosols	SCAQMD Standards - Reformulati	-1.1	0.0	-7,230	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Cutback Asphalt	Switch to emulsified asphalts	17.2	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	-0.9	0.0	-23	0
	Pesticide Application	Reformulation - FIP rule	-38.9	0.0	-361,287	0
	Recreational vehicles	CARB standards	-7.3	0.0	-3,884	0
	Motor Vehicles	Federal Reform	90.9	0.0	-129,011	0
	Motor Vehicles	Enhanced I/M	134.6	138.1	51,188	102,377
	Motor Vehicles	California LEV	-10.6	-24.8	-22,024	-22,024
		Total	169.0	109.6	-480,736	80,353
Beaumont, TX	Open Burning	Episodic Ban	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
		Total	0.0	0.0	0	0

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
Boston, MA	Utility Boiler - PC/Wall	SCR	0.0	0.0	0	0
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	0.0	0	0
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	0.0	0	0
	Utility Boiler - Cyclone	SCR	0.0	0.0	0	0
	Industrial Boiler - Stoker	SCR	0.0	0.0	0	0
	Industrial Boiler - Residual Oil	SCR	0.0	0.0	0	0
	Industrial Boiler - Distillate Oil	SCR	0.0	0.0	0	0
	Industrial Boiler - Natural Gas	SCR	0.0	0.0	0	0
	IC Engines - Natural Gas	NSCR	0.0	0.0	0	0
	IC Engines - Oil	SCR	0.0	0.0	0	0
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	0.0	0	0
	Area Source Industrial Oil Comb	RACT to small sources	0.0	0.0	0	0
	Area Source Industrial NG Comb	RACT to small sources	0.0	0.0	0	0
	Residential NG Consumption	LNB Space heaters	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	0.0	0	0
	Commercial Marine Vessels	Emission Fees	0.0	0.0	0	0
	Industrial Boiler - Other	SCR	0.0	0.0	0	0
	Industrial Cogeneration - Nat. Gas	SCR	0.0	0.0	0	0
	Glass Manufacturing - Container	Oxy-Firing	0.0	0.0	0	0
	Municipal Waste Combustors	SNCR	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Motor Vehicles	California LEV	0.0	0.0	0	0
	Motor Vehicles	Reform Diesel	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Chicago, IL	Open Burning	Episodic Ban	2,815.3	534.1	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	3,534.3	0.0	65,031,028	0
	Point Source Metal Surface Coating	FIP VOC Limits	7,008.5	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	78.8	0.0	1,971	0
	Point Sources	RE Improvements	9,297.3	0.0	18,594,560	0
	Bulk Terminals	RACT	156.2	0.0	260,239	0
	Metal product surface coating	VOC content limits & improved	3,668.8	0.0	128,230	0
	Wood product surface coating	Reformulation	26.6	0.0	682	0
	Wood furniture surface coating	Reformulation	1,275.3	0.0	1,590,807	0
	Adhesives - industrial	RACT	331.6	0.0	828,791	0
	Paper surface coating	Add-on control levels	40.3	0.0	3,027,556	0
	Miscellaneous surface coating	Add-on control levels	1,570.4	0.0	39,738,704	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	3,285.2	0.0	49,424,510	0
	Miscellaneous surface coating	MACT level of control	1,317.1	0.0	3,292,516	0
	Aerosols	SCAQMD Standards - Reformulati	2,458.6	0.0	15,363,210	0
	Aircraft surface coating	Add-on control levels	8.5	0.0	288,264	0
	marine surface coating	Add-on control levels	99.5	0.0	1,440,735	0
	Cutback Asphalt	Switch to emulsified asphalts	305.7	0.0	0	0
	Pharmaceutical manufacture	RACT	3.7	0.0	1,245	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	3,489.1	0.0	345,038	0

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
	Web Offset Lithography	New CTG (carbon adsorber)	36.2	0.0	-4,532	0
	Pesticide Application	Reformulation - FIP rule	479.6	0.0	4,459,519	0
	Recreational vehicles	CARB standards	1,404.9	0.0	744,518	0
	Motor Vehicles	California Reform	6,002.9	7,555.5	66,425,541	57,839,073
	Motor Vehicles	Enhanced I/M	1,994.0	1,579.0	630,296	1,260,592
	Motor Vehicles	California LEV	17,287.5	27,888.6	22,137,966	22,137,966
		Total	67,975.9	37,557.2	293,751,39 3	81,237,630
Cincinnati, OH	Open Burning	Episodic Ban	2,072.1	394.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	155.1	0.0	2,854,300	0
	Point Source Metal Surface Coating	FIP VOC Limits	455.9	0.0	0	0
	Point Sources	RE Improvements	857.1	0.0	1,714,040	0
	Bulk Terminals	RACT	151.5	0.0	252,353	0
	Metal product surface coating	VOC content limits & improved	239.9	0.0	7,037	0
	Wood product surface coating	Reformulation	9.1	0.0	254	0
	Wood furniture surface coating	Reformulation	746.9	0.0	315,871	0
	Adhesives - industrial	RACT	112.3	0.0	280,881	0
	Paper surface coating	Add-on control levels	43.5	0.0	3,044,887	0
	Miscellaneous surface coating	Add-on control levels	338.3	0.0	12,751,156	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	492.1	0.0	7,406,063	0
	Miscellaneous surface coating	MACT level of control	43.5	0.0	108,727	0
	Aerosols	SCAQMD Standards - Reformulati	565.1	0.0	3,532,770	0
	Aircraft surface coating	Add-on control levels	51.8	0.0	1,873,198	0
	marine surface coating	Add-on control levels	9.9	0.0	143,004	0
	Cutback Asphalt	Switch to emulsified asphalts	139.3	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	921.4	0.0	158,426	0
	Web Offset Lithography	New CTG (carbon adsorber)	9.6	0.0	-1,187	0
	Pesticide Application	Reformulation - FIP rule	130.7	0.0	1,213,893	0
	Recreational vehicles	CARB standards	212.6	0.0	112,612	0
	Motor Vehicles	California Reform	10,111.3	3,905.1	29,324,120	32,364,736
	Motor Vehicles	Enhanced I/M	11,801.5	8,822.8	872,858	1,745,717
	Motor Vehicles	California LEV	4,328.1	7,902.2	6,168,250	6,168,250
		Total	33,998.6	21,024.1	72,133,513	40,278,702
Dallas, TX	Open Burning	Episodic Ban	2,255.6	427.5	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	4,042.7	0.0	74,386,416	0
	Point Source Open Burning	Episodic Ban	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	204.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	208.0	0.0	5,202	0
	Point Sources	RE Improvements	14,125.2	0.0	28,250,270	0
	Bulk Terminals	RACT	712.2	0.0	1,186,847	0
	Metal product surface coating	VOC content limits & improved	1,188.4	0.0	42,077	0
	Wood product surface coating	Reformulation	19.1	0.0	959	0
	Wood furniture surface coating	Reformulation	711.9	0.0	592,881	0
	Adhesives - industrial	RACT	361.5	0.0	903,835	0

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Paper surface coating	Add-on control levels	77.3	0.0	6,161,139	0
	Miscellaneous surface coating	Add-on control levels	745.5	0.0	17,541,443	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	1,344.4	0.0	20,223,851	0
	Miscellaneous surface coating	MACT level of control	865.5	0.0	2,163,542	0
	Aerosols	SCAQMD Standards - Reformulati	1,192.9	0.0	7,455,390	0
	Aircraft surface coating	Add-on control levels	33.1	0.0	1,043,143	0
	marine surface coating	Add-on control levels	74.8	0.0	1,082,729	0
	SOCMI batch reactor processes	New CTG	1.7	0.0	7,007	0
	Cutback Asphalt	Switch to emulsified asphalts	519.3	0.0	0	0
	Petroleum refinery fugitives	RACT	167.1	0.0	-75,186	0
	Oiland natural gas production fiel	RACT (equipment/maintenance)	90.9	0.0	36,011	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	2,854.1	0.0	854,297	0
	Web Offset Lithography	New CTG (carbon adsorber)	48.6	0.0	-6,077	0
	Pesticide Application	Reformulation - FIP rule	184.5	0.0	1,715,814	0
	Recreational vehicles	CARB standards	795.3	0.0	421,475	0
	Motor Vehicles	Federal Reform	5,207.4	778.9	14,270,041	0
	Motor Vehicles	Enhanced I/M	27,236.5	20,913.7	2,475,143	4,950,287
	Motor Vehicles	California LEV	10,260.7	18,817.9	14,780,676	14,780,676
		Total	75,528.2	40,938.0	195,518,925	19,730,963
Fresno, CA	Adhesives - industrial	RACT	1.3	0.0	3,276	0
	Aerosols	CARB Tier 2 Standards - Reform	100.5	0.0	251,094	0
	Aerosols	SCAQMD Standards - Reformulati	100.5	0.0	1,004,376	0
	Automobile refinishing	CARB BARCT limits	51.8	0.0	190,706	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	198.0	0.0	3,567,537	0
	Bulk Terminals	RACT	21.8	0.0	36,371	0
	Cutback Asphalt	Switch to emulsified asphalts	14.0	0.0	0	0
	marine surface coating	Add-on control levels	11.1	0.0	160,048	0
	Metal product surface coating	VOC content limits & improved	67.4	0.0	1,680	0
	Miscellaneous surface coating	Add-on control levels	83.5	0.0	1,305,006	0
	Miscellaneous surface coating	MACT level of control	24.1	0.0	60,127	0
	Motor Vehicles	Enhanced I/M	194.8	329.3	77,881	155,763
	Nonroad gasoline	Reformulated gasoline	53.6	0.0	268,000	0
	Open Burning	Episodic Ban	230.7	43.8	0	0
	Paper surface coating	Add-on control levels	4.0	0.0	267,273	0
	Pesticide Application	Reformulation - FIP rule	530.9	0.0	4,937,073	0
	Point Source Metal Surface Coating	FIP VOC Limits	52.6	0.0	0	0
	Point Sources	RE Improvements	3,512.0	0.0	7,024,060	0
	Recreational vehicles	CARB standards	51.9	0.0	27,517	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	339.5	0.0	41,403	0
	Wood furniture surface coating	Reformulation	93.1	0.0	34,896	0
	Wood product surface coating	Reformulation	2.5	0.0	62	0
		Total	5,739.6	373.1	19,258,386	155,763

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
Grand Rapids, MI	Open Burning	Episodic Ban	838.2	158.8	0	0
	Point Sources	RE Improvements	6,025.1	0.0	12,050,110	0
	Metal product surface coating	VOC content limits & improved	199.1	0.0	4,981	0
	Wood product surface coating	Reformulation	6.5	0.0	298	0
	Wood furniture surface coating	Reformulation	5,374.7	0.0	2,015,519	0
	Adhesives - industrial	RACT	130.6	0.0	326,390	0
	Paper surface coating	Add-on control levels	28.4	0.0	1,816,557	0
	Miscellaneous surface coating	Add-on control levels	1,465.0	0.0	34,136,134	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	357.1	0.0	5,372,689	0
	Aerosols	SCAQMD Standards - Reformulati	249.4	0.0	1,558,560	0
	Aircraft surface coating	Add-on control levels	5.6	0.0	200,467	0
	marine surface coating	Add-on control levels	68.1	0.0	985,510	0
	Cutback Asphalt	Switch to emulsified asphalts	85.3	0.0	0	0
	Pharmaceutical manufacture	RACT	138.2	0.0	46,285	0
	Oiland natural gas production fiel	RACT (equipment/maintenance)	37.2	0.0	14,770	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	355.9	0.0	8,899	0
	Web Offset Lithography	New CTG (carbon adsorber)	8.5	0.0	-1,067	0
	Pesticide Application	Reformulation - FIP rule	81.1	0.0	753,356	0
	Recreational vehicles	CARB standards	660.0	0.0	349,778	0
	Motor Vehicles	California Reform	5,771.8	2,152.6	17,444,686	16,125,166
	Motor Vehicles	Enhanced I/M	5,589.0	4,425.7	456,892	913,783
	Motor Vehicles	California LEV	2,132.3	3,930.0	3,060,281	3,060,281
		Total	29,607.1	10,667.1	80,601,094	20,099,230
Hartford, CT	Open Burning	Episodic Ban	890.4	168.9	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	5.8	0.0	107,456	0
	Point Source Metal Surface Coating	FIP VOC Limits	102.9	0.0	0	0
	Metal product surface coating	VOC content limits & improved	90.3	0.0	12,139	0
	Wood product surface coating	Reformulation	4.7	0.0	116	0
	Wood furniture surface coating	Reformulation	46.7	0.0	74,532	0
	Paper surface coating	Add-on control levels	13.7	0.0	1,374,240	0
	Miscellaneous surface coating	Add-on control levels	43.6	0.0	3,164,929	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	269.8	0.0	7,859,989	0
	Aerosols	SCAQMD Standards - Reformulati	276.6	0.0	1,728,300	0
	Aircraft surface coating	Add-on control levels	115.6	0.0	6,053,206	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	467.5	0.0	11,687	0
	Pesticide Application	Reformulation - FIP rule	12.5	0.0	115,841	0
	Recreational vehicles	CARB standards	296.1	0.0	156,879	0
	Motor Vehicles	California Reform	710.1	1,313.5	486,500	19,984,065
	Motor Vehicles	California LEV	2,649.3	4,889.5	3,811,174	3,811,174
		Total	5,995.6	6,371.9	24,956,988	23,795,239
Houston, TX	Open Burning	Episodic Ban	73.7	13.8	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	85.0	0.0	1,564,828	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Point Source Wood Product Coating	FIP VOC Limits	62.8	0.0	1,570	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Bulk Terminals	RACT	203.7	0.0	339,507	0
	Metal product surface coating	VOC content limits & improved	5.1	0.0	129	0
	Wood product surface coating	Reformulation	1.5	0.0	38	0
	Wood furniture surface coating	Reformulation	12.1	0.0	4,536	0
	Adhesives - industrial	RACT	27.2	0.0	68,115	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	2.6	0.0	46,902	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	13.3	0.0	200,944	0
	Miscellaneous surface coating	MACT level of control	2.2	0.0	5,479	0
	Aerosols	SCAQMD Standards - Reformulati	35.7	0.0	223,770	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Cutback Asphalt	Switch to emulsified asphalts	112.6	0.0	0	0
	Oiland natural gas production fiel	RACT (equipment/maintenance)	11.8	0.0	4,674	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	260.9	0.0	195,467	0
	Web Offset Lithography	New CTG (carbon adsorber)	10.5	0.0	-1,319	0
	Pesticide Application	Reformulation - FIP rule	105.6	0.0	981,616	0
	Recreational vehicles	CARB standards	21.5	0.0	11,363	0
	Motor Vehicles	Federal Reform	1,537.0	173.5	4,941,337	0
	Motor Vehicles	Enhanced I/M	888.9	750.5	291,551	583,103
	Motor Vehicles	California LEV	279.7	633.8	471,922	471,922
		Total	3,753.4	1,571.6	9,352,429	1,055,025
Huntington, WV	Open Burning	Episodic Ban	461.9	87.1	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	12.4	0.0	228,344	0
	Point Sources	RE Improvements	6,281.0	0.0	12,561,840	0
	Bulk Terminals	RACT	36.6	0.0	60,913	0
	Metal product surface coating	VOC content limits & improved	43.3	0.0	1,721	0
	Wood furniture surface coating	Reformulation	26.8	0.0	10,523	0
	Adhesives - industrial	RACT	24.5	0.0	61,210	0
	Miscellaneous surface coating	Add-on control levels	10.0	0.0	164,121	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	61.0	0.0	917,840	0
	Miscellaneous surface coating	MACT level of control	13.7	0.0	34,223	0
	Aerosols	SCAQMD Standards - Reformulati	106.8	0.0	666,870	0
	marine surface coating	Add-on control levels	5.7	0.0	82,393	0
	SOCMI batch reactor processes	New CTG	105.1	0.0	426,152	0
	Cutback Asphalt	Switch to emulsified asphalts	89.7	0.0	0	0
	SOCMI fugitives	RACT	61.3	0.0	8,345	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	244.1	0.0	93,639	0
	Web Offset Lithography	New CTG (carbon adsorber)	8.9	0.0	-1,118	0
	Pesticide Application	Reformulation - FIP rule	4.3	0.0	39,618	0
	Recreational vehicles	CARB standards	35.7	0.0	18,917	0
	Motor Vehicles	California Reform	1,767.2	782.3	6,151,689	5,771,978
	Motor Vehicles	Enhanced I/M	2,025.9	1,628.6	298,423	596,847

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
	Motor Vehicles	California LEV	726.0	1,426.9	1,091,952	1,091,952
		Total	12,151.9	3,924.9	22,917,615	7,460,777
Los Angeles, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Macon, GA	Utility Boiler - PC/Wall	SCR	0.0	28,812.3	0	98,504,407
	Industrial Boiler - PC	SCR	0.0	408.0	0	3,211,810
	Industrial Boiler - Stoker	SCR	0.0	160.3	0	723,909
	Industrial Boiler - Residual Oil	SCR	0.0	35.1	0	89,951
	Industrial Boiler - Distillate Oil	SCR	0.0	12.4	0	58,747
	Industrial Boiler - Natural Gas	SCR	0.0	855.4	0	3,059,200
	Area Source Industrial NG Comb	RACT to small sources	0.0	41.0	0	70,666
	Open Burning	Episodic Ban	656.6	124.6	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	39.5	0	322,834
	Glass Manufacturing - Container	Oxy-Firing	0.0	42.5	0	266,848
	Cement Manufacturing - Dry	SCR	0.0	493.1	0	2,359,895
	Cement Manufacturing - Wet	SCR	0.0	419.6	0	1,675,408
	Motor Vehicles	California Reform	3,119.2	1,037.4	8,244,797	7,735,816
	Motor Vehicles	Enhanced I/M	2,797.9	2,220.0	907,374	1,814,747
	Motor Vehicles	California LEV	1,055.4	1,894.1	1,468,434	1,468,434
	Motor Vehicles	Reform Diesel	0.0	120.3	0	1,717,327
		Total	7,629.1	36,715.6	10,620,604	123,079,999
Modesto, CA	Aerosols	CARB Tier 2 Standards - Reform	46.7	0.0	116,760	0

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Aerosols	SCAQMD Standards - Reformulati	46.7	0.0	467,040	0
	Automobile refinishing	CARB BARCT limits	30.0	0.0	110,381	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	114.6	0.0	2,064,926	0
	Metal product surface coating	VOC content limits & improved	352.8	0.0	8,725	0
	Miscellaneous surface coating	Add-on control levels	64.2	0.0	1,006,908	0
	Miscellaneous surface coating	MACT level of control	17.1	0.0	42,760	0
	Nonroad gasoline	Reformulated gasoline	25.1	0.0	125,500	0
	Open Burning	Episodic Ban	97.6	18.5	0	0
	Paper surface coating	Add-on control levels	9.4	0.0	632,619	0
	Pesticide Application	Reformulation - FIP rule	108.9	0.0	1,012,621	0
	Point Source Ind. Surface Coating	Add-on Control Levels	74.1	0.0	1,363,348	0
	Point Source Metal Surface Coating	FIP VOC Limits	61.0	0.0	0	0
	Recreational vehicles	CARB standards	24.4	0.0	12,907	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	131.9	0.0	3,297	0
	Wood furniture surface coating	Reformulation	78.4	0.0	29,408	0
	Wood product surface coating	Reformulation	2.5	0.0	63	0
		Total	1,285.4	18.5	6,997,263	0
Nashville, TN	Utility Boiler - PC/Tangential	SCR	0.0	10,608.4	0	38,924,513
	Industrial Boiler - PC	SCR	0.0	224.4	0	4,796,549
	Industrial Boiler - Stoker	SCR	0.0	39.7	0	413,030
	Industrial Boiler - Residual Oil	SCR	0.0	5.2	0	35,640
	Industrial Boiler - Distillate Oil	SCR	0.0	19.8	0	213,310
	Industrial Boiler - Natural Gas	SCR	0.0	225.7	0	1,841,638
	IC Engines - Natural Gas	NSCR	0.0	1,474.8	0	1,313,705
	Gas Turbines - Natural Gas	SCR + STEAM INJECTION	0.0	37.3	0	801,585
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	246.5	0	5,652,452
	Process Heaters - Natural Gas	LNB + SCR	0.0	11.3	0	174,243
	Area Source Industrial Coal Comb	RACT to small sources	0.0	27.7	0	107,750
	Open Burning	Episodic Ban	746.4	141.4	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	104.6	0	852,643
	Commercial Marine Vessels	Emission Fees	0.0	27.6	0	274,516
	Municipal Waste Combustors	SNCR	0.0	131.6	0	439,269
	Motor Vehicles	California Reform	6,233.1	2,567.0	21,478,978	20,150,267
	Motor Vehicles	Enhanced I/M	6,669.3	5,484.2	567,807	1,135,613
	Motor Vehicles	California LEV	2,738.0	4,903.5	3,839,754	3,839,754
	Motor Vehicles	Reform Diesel	0.0	265.6	0	3,869,653
		Total	16,386.8	26,546.3	25,886,538	84,836,130
New London, CT	Open Burning	Episodic Ban	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Motor Vehicles	California LEV	0.0	0.0	0	0
		Total	0.0	0.0	0	0
New York, NY	Open burning	Seasonal/episodic ban	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Motor Vehicles	Enhanced I/M	0.0	0.0	0	0
	Motor Vehicles	California LEV	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Owensboro, KY	Utility Boiler - PC/Wall	SCR	0.0	4,635.5	0	21,299,059
	Utility Boiler - PC/Tangential	SCR	0.0	1,944.4	0	7,109,311
	Utility Boiler - Cyclone	SCR	0.0	849.3	0	17,090,889
	Industrial Boiler - Stoker	SCR	0.0	98.9	0	1,015,716
	Industrial Boiler - Residual Oil	SCR	0.0	2.6	0	18,936
	Industrial Boiler - Natural Gas	SCR	0.0	30.5	0	244,273
	Area Source Industrial Coal Comb	RACT to small sources	0.0	94.6	0	354,725
	Area Source Industrial Oil Comb	RACT to small sources	0.0	8.8	0	18,458
	Area Source Industrial NG Comb	RACT to small sources	0.0	172.4	0	272,704
	Open Burning	Episodic Ban	168.3	31.9	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	6.4	0	52,795
	Commercial Marine Vessels	Emission Fees	0.0	307.2	0	3,072,058
	Motor Vehicles	California Reform	613.7	219.5	2,568,215	818,529

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Motor Vehicles	Enhanced I/M	740.2	470.9	191,738	383,477
	Motor Vehicles	California LEV	226.7	400.1	310,311	310,311
		Total	1,748.9	9,273.0	3,070,263	52,061,240
Philadelphia, PA	Open Burning	Episodic Ban	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Motor Vehicles	California LEV	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Portland, OR	Bulk Terminals	RACT	219.5	0.0	365,885	0
	Cutback Asphalt	Switch to emulsified asphalts	208.2	0.0	0	0
	Metal product surface coating	VOC content limits & improved	382.9	0.0	9,546	0
	Motor Vehicles	Enhanced I/M	10,296.0	9,747.0	1,458,678	2,917,357
	Open Burning	Episodic Ban	2,140.3	405.9	0	0
	Pharmaceutical manufacture	RACT	4.2	0.0	1,408	0
	Point Source Metal Surface Coating	FIP VOC Limits	139.8	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	217.2	0.0	5,429	0
	Point Sources	RE Improvements	19,187.0	0.0	38,373,910	0
	Recreational vehicles	CARB standards	379.1	0.0	200,932	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,190.7	0.0	381,602	0
	SOCMI fugitives	RACT	12.7	0.0	1,729	0
	Web Offset Lithography	New CTG (carbon adsorber)	249.0	0.0	-31,123	0
	Wood furniture surface coating	Reformulation	466.6	0.0	175,013	0
	Wood product surface coating	Reformulation	42.0	0.0	1,745	0
		Total	35,135.2	10,152.9	40,944,754	2,917,357
Providence, RI	Open Burning	Episodic Ban	560.1	106.4	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	177.8	0.0	3,270,692	0

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Point Source Metal Surface Coating	FIP VOC Limits	129.6	0.0	0	0
	Point Sources	RE Improvements	2,381.3	0.0	4,762,520	0
	Metal product surface coating	VOC content limits & improved	481.8	0.0	11,958	0
	Wood product surface coating	Reformulation	5.6	0.0	141	0
	Wood furniture surface coating	Reformulation	403.0	0.0	151,099	0
	Paper surface coating	Add-on control levels	3.3	0.0	220,089	0
	Miscellaneous surface coating	Add-on control levels	195.0	0.0	3,156,486	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	434.2	0.0	6,533,259	0
	Miscellaneous surface coating	MACT level of control	148.9	0.0	372,146	0
	Aerosols	SCAQMD Standards - Reformulati	296.8	0.0	1,854,330	0
	marine surface coating	Add-on control levels	134.5	0.0	1,946,944	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	356.5	0.0	8,909	0
	Pesticide Application	Reformulation - FIP rule	2.8	0.0	26,709	0
	Recreational vehicles	CARB standards	789.7	0.0	418,473	0
	Motor Vehicles	California Reform	590.1	1,002.0	737,000	15,574,996
	Motor Vehicles	California LEV	2,302.1	3,756.5	2,980,279	2,980,279
		Total	9,393.1	4,864.9	26,451,034	18,555,275
Sacramento, CA	Aerosols	CARB Tier 2 Standards - Reform	190.8	0.0	476,892	0
	Aerosols	SCAQMD Standards - Reformulati	190.7	0.0	1,907,568	0
	Automobile refinishing	CARB BARCT limits	123.8	0.0	455,517	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	472.8	0.0	8,521,420	0
	marine surface coating	Add-on control levels	4.2	0.0	60,687	0
	Metal product surface coating	VOC content limits & improved	228.4	0.0	5,663	0
	Miscellaneous surface coating	Add-on control levels	116.6	0.0	1,886,434	0
	Miscellaneous surface coating	MACT level of control	91.7	0.0	229,219	0
	Nonroad gasoline	Reformulated gasoline	101.3	0.0	506,500	0
	Open Burning	Episodic Ban	429.8	81.3	0	0
	Paper surface coating	Add-on control levels	3.1	0.0	206,239	0
	Pesticide Application	Reformulation - FIP rule	113.8	0.0	1,058,898	0
	Point Source Ind. Surface Coating	Add-on Control Levels	361.7	0.0	6,655,556	0
	Point Source Metal Surface Coating	FIP VOC Limits	313.9	0.0	0	0
	Point Sources	RE Improvements	40.5	0.0	81,030	0
	Recreational vehicles	CARB standards	97.3	0.0	51,601	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	646.7	0.0	16,167	0
	Wood furniture surface coating	Reformulation	240.2	0.0	90,098	0
	Wood product surface coating	Reformulation	16.0	0.0	399	0
		Total	3,783.3	81.3	22,209,888	0
San Diego, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Springfield, MA	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	256.4	0	6,961,478
	Industrial Boiler - PC	SCR	0.0	44.3	0	948,195
	Industrial Boiler - Stoker	SCR	0.0	108.2	0	1,127,084
	Industrial Boiler - Residual Oil	SCR	0.0	141.9	0	976,271
	Industrial Boiler - Natural Gas	SCR	0.0	159.9	0	1,342,660
	IC Engines - Natural Gas	NSCR	0.0	58.5	0	179,810
	Gas Turbines - Natural Gas	SCR + STEAM INJECTION	0.0	106.6	0	511,328
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	146.7	0	731,902
	Residential NG Consumption	LNB Space heaters	0.0	531.5	0	653,642
	Open Burning	Episodic Ban	2,129.9	404.0	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	33.8	0	275,292
	Commercial Marine Vessels	Emission Fees	0.0	252.3	0	2,523,158
	Motor Vehicles	California Reform	398.0	672.7	467,000	10,679,254
	Motor Vehicles	California LEV	1,714.3	2,857.2	2,038,322	2,038,322
	Motor Vehicles	Reform Diesel	0.0	134.5	0	1,911,328
		Total	4,242.2	5,908.5	2,505,322	30,859,724
Visalia, CA	Aerosols	CARB Tier 2 Standards - Reform	42.6	0.0	106,380	0
	Automobile refinishing	CARB BARCT limits	11.2	0.0	41,327	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	42.9	0.0	773,106	0
	Metal product surface coating	VOC content limits & improved	49.9	0.0	1,238	0
	Miscellaneous surface coating	Add-on control levels	22.0	0.0	333,737	0
	Miscellaneous surface coating	MACT level of control	19.7	0.0	49,270	0
	Nonroad gasoline	Reformulated gasoline	23.1	0.0	115,500	0
	Open Burning	Episodic Ban	93.7	17.7	0	0
	Paper surface coating	Add-on control levels	1.1	0.0	76,493	0
	Pesticide Application	Reformulation - FIP rule	250.4	0.0	2,329,073	0
	Recreational vehicles	CARB standards	22.4	0.0	11,867	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	110.8	0.0	2,770	0
	Wood furniture surface coating	Reformulation	8.2	0.0	3,088	0
	Wood product surface coating	Reformulation	2.7	0.0	67	0
		Total	700.7	17.7	3,843,916	0

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year)		Costs (1990$)	
			VOC	NOx	VOC	NOx
Washington, DC	Utility Boiler - PC/Wall	SCR	0.0	28,076.6	0	86,025,342
	Utility Boiler - PC/Tangential	SCR	0.0	25,456.0	0	101,567,747
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	5,738.6	0	52,216,489
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	3,364.4	0	41,194,478
	Utility Boiler - Cyclone	SCR	0.0	2,833.2	0	33,909,713
	Industrial Boiler - PC	SCR	0.0	3,950.8	0	31,280,313
	Industrial Boiler - Stoker	SCR	0.0	111.5	0	1,161,708
	Industrial Boiler - Residual Oil	SCR	0.0	713.4	0	4,674,888
	Industrial Boiler - Distillate Oil	SCR	0.0	107.4	0	1,126,417
	Industrial Boiler - Natural Gas	SCR	0.0	936.8	0	7,865,392
	IC Engines - Oil	SCR	0.0	362.2	0	1,968,033
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	48.8	0	2,592,825
	Process Heaters - Natural Gas	LNB + SCR	0.0	6.3	0	183,156
	Area Source Industrial Coal Comb	RACT to small sources	0.0	29.7	0	118,154
	Area Source Industrial Oil Comb	RACT to small sources	0.0	13.1	0	20,421
	Area Source Industrial NG Comb	RACT to small sources	0.0	45.6	0	65,735
	Residential NG Consumption	LNB Space heaters	0.0	2,607.8	0	3,207,326
	Open Burning	Episodic Ban	911.4	173.4	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	486.9	0	3,972,107
	Commercial Marine Vessels	Emission Fees	0.0	536.0	0	5,358,057
	Industrial Boiler - Other	SCR	0.0	15.8	0	169,106
	Glass Manufacturing - Container	Oxy-Firing	0.0	59.9	0	396,919
	Cement Manufacturing - Dry	SCR	0.0	2,187.8	0	11,048,592
	Cement Manufacturing - Wet	SCR	0.0	808.4	0	3,405,438
	Iron & Steel Mills - Reheating	LNB + FGR	0.0	444.8	0	233,562
	Iron & Steel Mills - Annealing	LNB + SCR	0.0	70.3	0	360,338
	Municipal Waste Combustors	SNCR	0.0	140.2	0	467,984
	Point Source Ind. Surface Coating	Add-on Control Levels	353.0	0.0	6,494,372	0
	Point Source Metal Surface Coating	FIP VOC Limits	824.2	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	7.3	0.0	183	0
	Point Sources	RE Improvements	5,634.0	0.0	11,268,280	0
	Bulk Terminals	RACT	833.1	0.0	1,388,281	0
	Metal product surface coating	VOC content limits & improved	645.8	0.0	28,410	0
	Wood product surface coating	Reformulation	26.9	0.0	810	0
	Wood furniture surface coating	Reformulation	1,229.7	0.0	469,264	0
	Adhesives - industrial	RACT	176.5	0.0	441,529	0
	Paper surface coating	Add-on control levels	83.3	0.0	3,404,679	0
	Miscellaneous surface coating	Add-on control levels	455.2	0.0	8,406,296	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	2,273.6	0.0	34,205,397	0
	Miscellaneous surface coating	MACT level of control	129.3	0.0	323,092	0
	Aerosols	SCAQMD Standards - Reformulati	1,895.6	0.0	11,844,990	0
	Aircraft surface coating	Add-on control levels	21.9	0.0	787,137	0
	marine surface coating	Add-on control levels	105.4	0.0	1,522,900	0
	Cutback Asphalt	Switch to emulsified asphalts	234.1	0.0	0	0
	Synthetic fiber manufacture	RACT (adsorber)	1,408.2	0.0	1,991,973	0

Table B-7 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Service stations - stage I-truck un	Vapor balance & P-V valves	3,690.7	0.0	604,238	0
	Web Offset Lithography	New CTG (carbon adsorber)	38.2	0.0	-4,787	0
	Pesticide Application	Reformulation - FIP rule	233.8	0.0	2,173,301	0
	Recreational vehicles	CARB standards	838.9	0.0	444,536	0
	Motor Vehicles	Federal Reform	2,980.7	580.8	12,457,815	0
	Motor Vehicles	Enhanced I/M	2,309.2	2,294.4	881,214	1,762,429
	Motor Vehicles	California LEV	15,654.8	28,610.7	22,493,022	22,493,022
	Motor Vehicles	Reform Diesel	0.0	1,483.5	0	21,669,143
		Total	42,994.8	112,295.1	121,626,932	440,514,833

Table B-8. Alternative 8H1AX-80: Marginal Emission Reductions and Costs by Nonattainment Area and Control Measure Under the LCS

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
Allentown, PA	Open Burning	Episodic Ban	522.3	99.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	66.4	0.0	0	0
	Point Sources	RE Improvements	40.5	0.0	81,030	0
	Metal product surface coating	VOC content limits & improved	125.3	0.0	3,132	0
	Wood product surface coating	Reformulation	2.0	0.0	49	0
	Wood furniture surface coating	Reformulation	98.0	0.0	100,469	0
	Paper surface coating	Add-on control levels	3.3	0.0	222,718	0
	Miscellaneous surface coating	Add-on control levels	63.5	0.0	3,580,162	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	220.0	0.0	3,310,551	0
	Aerosols	SCAQMD Standards - Reformulati	165.8	0.0	1,036,530	0
	marine surface coating	Add-on control levels	2.0	0.0	28,661	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	202.2	0.0	5,056	0
	Pesticide Application	Reformulation - FIP rule	28.5	0.0	265,497	0
	Recreational vehicles	CARB standards	70.5	0.0	37,302	0
	Motor Vehicles	California Reform	304.6	566.5	230,000	8,428,826
	Motor Vehicles	Enhanced I/M	340.0	237.2	94,640	189,279
	Motor Vehicles	California LEV	1,158.1	2,060.6	1,603,354	1,603,354
		Total	3,413.0	2,963.3	10,599,150	10,221,459
Athens, GA	Industrial Boiler - Stoker	SNCR	0.0	3.7	0	7,766
	Industrial Boiler - Residual Oil	SCR	0.0	8.7	0	22,258
	Industrial Boiler - Distillate Oil	LNB	0.0	2.7	0	3,765
	Industrial Boiler - Natural Gas	SCR	0.0	205.6	0	730,049
	Area Source Industrial NG Comb	RACT to small sources	0.0	13.4	0	22,673
	Open Burning	Episodic Ban	148.2	28.1	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	15.0	0	122,028
	Motor Vehicles	California Reform	1,163.9	424.9	3,244,410	3,045,364
	Motor Vehicles	Enhanced I/M	1,037.8	888.7	356,005	712,011
	Motor Vehicles	California LEV	389.6	757.6	576,178	576,178
	Motor Vehicles	Reform Diesel	0.0	49.6	0	756,347
		Total	2,739.5	2,398.0	4,176,593	5,998,439
Atlanta, GA	Utility Boiler - PC/Wall	SCR	0.0	26,524.7	0	88,115,238
	Utility Boiler - PC/Tangential	SCR	0.0	48,973.9	0	169,190,588
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	1,311.5	0	9,837,161
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	5.2	0	2,423,615
	Industrial Boiler - PC	SCR	0.0	1,594.6	0	15,090,051
	Industrial Boiler - Stoker	SCR	0.0	41.5	0	186,329
	Industrial Boiler - Residual Oil	SCR	0.0	781.1	0	2,315,996
	Industrial Boiler - Distillate Oil	SCR	0.0	23.0	0	130,734
	Industrial Boiler - Natural Gas	SCR	0.0	1,057.8	0	4,070,197
	IC Engines - Natural Gas	NSCR	0.0	189.8	0	140,995
	Area Source Industrial NG Comb	RACT to small sources	0.0	82.2	0	140,967
	Open Burning	Episodic Ban	2,803.3	531.5	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	351.8	0	2,869,290

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
	Glass Manufacturing - Container	Oxy-Firing	0.0	720.8	0	4,774,851
	Cement Manufacturing - Dry	SCR	0.0	451.5	0	2,279,852
	Motor Vehicles	California Reform	14,818.9	9,276.1	86,558,425	81,497,785
	Motor Vehicles	Enhanced I/M	4,661.3	4,386.8	1,703,128	3,406,256
	Motor Vehicles	California LEV	10,972.5	19,802.5	15,536,781	15,536,781
	Motor Vehicles	Reform Diesel	0.0	1,065.8	0	15,564,564
		Total	33,256.0	117,172.1	103,798,334	417,571,250
Augusta, GA	Utility Boiler - PC/Tangential	SCR	0.0	2,269.6	0	12,239,652
	Industrial Boiler - PC	SCR	0.0	5,957.0	0	46,310,139
	Industrial Boiler - Stoker	SCR	0.0	851.4	0	3,819,644
	Industrial Boiler - Residual Oil	SCR	0.0	929.5	0	2,713,729
	Industrial Boiler - Distillate Oil	SCR	0.0	75.1	0	350,197
	Industrial Boiler - Natural Gas	SCR	0.0	1,622.2	0	5,775,774
	Nitric Acid Manufacturing Plant	NSCR	0.0	1,132.3	0	797,910
	Area Source Industrial Coal Comb	RACT to small sources	0.0	15.7	0	62,428
	Area Source Industrial Oil Comb	RACT to small sources	0.0	3.8	0	8,147
	Area Source Industrial NG Comb	RACT to small sources	0.0	77.0	0	130,543
	Open Burning	Episodic Ban	738.5	140.1	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	52.2	0	425,056
	Motor Vehicles	California Reform	4,227.9	1,369.9	10,744,730	10,078,541
	Motor Vehicles	Enhanced I/M	3,669.3	2,903.1	1,181,263	2,362,526
	Motor Vehicles	California LEV	1,359.9	2,478.2	1,911,700	1,911,700
	Motor Vehicles	Reform Diesel	0.0	162.7	0	2,290,691
		Total	9,995.6	20,039.8	13,837,693	89,276,677
Austin, TX	Open Burning	Episodic Ban	375.7	71.1	0	0
	Bulk Terminals	RACT	485.2	0.0	808,657	0
	Metal product surface coating	VOC content limits & improved	107.3	0.0	2,674	0
	Wood product surface coating	Reformulation	2.5	0.0	63	0
	Wood furniture surface coating	Reformulation	161.2	0.0	60,460	0
	Adhesives - industrial	RACT	518.3	0.0	1,295,885	0
	Miscellaneous surface coating	MACT level of control	234.3	0.0	585,769	0
	Aerosols	CARB Tier 2 Standards - Reform	125.5	0.0	313,854	0
	Cutback Asphalt	Switch to emulsified asphalts	792.2	0.0	0	0
	SOCMI fugitives	RACT	12.8	0.0	1,739	0
	Pharmaceutical manufacture	RACT	106.2	0.0	35,568	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	87.4	0.0	34,636	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,594.6	0.0	1,194,723	0
	Web Offset Lithography	New CTG (carbon adsorber)	161.9	0.0	-20,255	0
	Recreational vehicles	CARB standards	168.0	0.0	89,049	0
	Motor Vehicles	Enhanced I/M	6,268.9	4,560.1	1,872,174	3,744,347
		Total	11,202.0	4,631.2	6,274,996	3,744,347

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
Bakersfield, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.7	0.0	16	0
		Total	0.7	0.0	16	0
Bangor, ME	Utility Boiler - Oil-Gas/Wall	SCR	0.0	50.1	0	5,697,710
	Industrial Boiler - Residual Oil	SCR	0.0	1,040.4	0	7,152,915
	Area Source Industrial Oil Comb	RACT to small sources	0.0	6.2	0	12,504
	Area Source Industrial NG Comb	RACT to small sources	0.0	3.1	0	4,509
	Residential NG Consumption	LNB Space heaters	0.0	10.7	0	17,152
	Open Burning	Episodic Ban	686.3	130.1	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	4.2	0	33,156
	Commercial Marine Vessels	Emission Fees	0.0	8.5	0	85,048
	Motor Vehicles	California Reform	983.4	775.4	3,212,613	8,241,243
	Motor Vehicles	Enhanced I/M	1,671.7	1,380.8	550,911	1,101,822
	Motor Vehicles	California LEV	963.4	2,042.8	1,549,621	1,549,621
	Motor Vehicles	Reform Diesel	0.0	159.3	0	2,436,714
		Total	4,304.8	5,611.6	5,313,145	26,332,394
Barnstable, MA	Utility Boiler - Oil-Gas/Wall	SCR	0.0	5,418.1	0	21,157,763
	Residential NG Consumption	LNB Space heaters	0.0	43.7	0	70,375
	Open Burning	Episodic Ban	28.8	5.5	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	19.4	0	158,751
	Motor Vehicles	California Reform	112.7	187.6	192,000	2,696,295
	Motor Vehicles	California LEV	354.2	750.6	508,058	508,058
	Motor Vehicles	Reform Diesel	0.0	49.6	0	754,159
		Total	495.7	6,474.5	700,058	25,345,401
Baton Rouge, LA	Open Burning	Episodic Ban	14.5	2.7	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.7	0.0	42	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Adhesives - industrial	RACT	3.0	0.0	7,459	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	2.1	0.0	5,299	0
	Aerosols	SCAQMD Standards - Reformulati	6.7	0.0	41,850	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Cutback Asphalt	Switch to emulsified asphalts	17.2	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	5.6	0.0	139	0
	Pesticide Application	Reformulation - FIP rule	2.9	0.0	26,951	0
	Recreational vehicles	CARB standards	10.2	0.0	5,399	0
	Motor Vehicles	Federal Reform	161.9	31.9	475,253	0
	Motor Vehicles	Enhanced I/M	134.6	138.1	51,188	102,377
	Motor Vehicles	California LEV	49.6	113.3	82,863	82,863
		Total	409.0	286.0	696,443	185,240
Beaumont, TX	Open Burning	Episodic Ban	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.8	0.0	27	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
		Total	0.8	0.0	27	0
Birmingham, AL	Utility Boiler - PC/Wall	SCR	0.0	29,995.2	0	114,055,991
	Utility Boiler - PC/Tangential	SCR	0.0	7,589.1	0	25,043,588
	Industrial Boiler - PC	SCR	0.0	4.8	0	121,708
	Industrial Boiler - Natural Gas	SCR	0.0	28.0	0	223,625
	Area Source Industrial Coal Comb	RACT to small sources	0.0	36.2	0	145,287
	Area Source Industrial Oil Comb	RACT to small sources	0.0	7.0	0	15,288
	Area Source Industrial NG Comb	RACT to small sources	0.0	393.2	0	662,240
	Open Burning	Episodic Ban	1,025.0	194.7	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	87.8	0	716,135
	Cement Manufacturing - Dry	SCR	0.0	1,777.4	0	8,544,422
	Cement Manufacturing - Wet	SCR	0.0	558.7	0	2,240,339
	Motor Vehicles	California Reform	6,580.6	2,308.5	19,203,301	18,051,111
	Motor Vehicles	Enhanced I/M	7,143.8	5,024.0	2,125,452	4,250,905
	Motor Vehicles	California LEV	2,454.5	4,354.9	3,439,368	3,439,368
	Motor Vehicles	Reform Diesel	0.0	237.2	0	3,465,787
		Total	17,203.9	52,596.7	24,768,121	180,975,793
Boston, MA	Utility Boiler - PC/Wall	SCR	0.0	0.0	0	0
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	0.0	0	0
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	0.0	0	0
	Utility Boiler - Cyclone	SCR	0.0	0.0	0	0
	Industrial Boiler - Stoker	SCR	0.0	0.0	0	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Industrial Boiler - Residual Oil	SCR	0.0	0.0	0	0
	Industrial Boiler - Distillate Oil	SCR	0.0	0.0	0	0
	Industrial Boiler - Natural Gas	SCR	0.0	0.0	0	0
	IC Engines - Natural Gas	NSCR	0.0	0.0	0	0
	IC Engines - Oil	SCR	0.0	0.0	0	0
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	0.0	0	0
	Area Source Industrial Coal Comb	RACT to small sources	0.0	1.2	0	4,177
	Area Source Industrial Oil Comb	RACT to small sources	0.0	0.0	0	0
	Area Source Industrial NG Comb	RACT to small sources	0.0	0.0	0	0
	Residential NG Consumption	LNB Space heaters	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	0.0	0	0
	Commercial Marine Vessels	Emission Fees	0.0	0.0	0	0
	Industrial Boiler - Other	SCR	0.0	0.0	0	0
	Industrial Cogeneration - Nat. Gas	SCR	0.0	0.0	0	0
	Glass Manufacturing - Container	Oxy-Firing	0.0	0.0	0	0
	Municipal Waste Combustors	SNCR	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Motor Vehicles	California LEV	0.0	0.0	0	0
	Motor Vehicles	Reform Diesel	0.0	0.0	0	0
		Total	0.0	1.2	0	4,177
Charlotte, NC	Utility Boiler - PC/Wall	SCR	0.0	17,770.5	0	55,135,167
	Utility Boiler - PC/Tangential	SCR	0.0	8,775.0	0	54,917,608
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	1,063.8	0	6,836,668
	Industrial Boiler - PC	SCR	0.0	4,375.4	0	34,162,612
	Industrial Boiler - Stoker	SCR	0.0	21.5	0	223,817
	Industrial Boiler - Residual Oil	SCR	0.0	391.3	0	1,842,444
	Industrial Boiler - Distillate Oil	SCR	0.0	0.2	0	2,849
	Industrial Boiler - Natural Gas	SCR	0.0	95.3	0	368,848
	Area Source Industrial Coal Comb	RACT to small sources	0.0	150.6	0	600,700
	Area Source Industrial Oil Comb	RACT to small sources	0.0	12.8	0	28,822
	Area Source Industrial NG Comb	RACT to small sources	0.0	179.7	0	301,317
	Open Burning	Episodic Ban	1,284.1	243.5	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	129.0	0	1,053,617
	Motor Vehicles	California Reform	8,366.8	3,083.8	25,352,918	23,743,252
	Motor Vehicles	Enhanced I/M	8,040.1	6,549.9	1,492,409	2,984,818
	Motor Vehicles	California LEV	3,254.9	5,749.9	4,510,636	4,510,636
	Motor Vehicles	Reform Diesel	0.0	347.0	0	5,111,750
		Total	20,945.9	48,939.2	31,355,963	191,824,925
Chattanooga, TN	Industrial Boiler - PC	SCR	0.0	802.4	0	6,328,215
	Industrial Boiler - Stoker	SCR	0.0	621.2	0	2,842,055
	Industrial Boiler - Residual Oil	SCR	0.0	200.1	0	586,747
	Industrial Boiler - Distillate Oil	SCR	0.0	22.0	0	106,982
	Industrial Boiler - Natural Gas	SCR	0.0	613.2	0	2,187,373
	Area Source Industrial Coal Comb	RACT to small sources	0.0	18.2	0	71,177

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Area Source Industrial NG Comb	RACT to small sources	0.0	41.8	0	71,643
	Open Burning	Episodic Ban	1,011.9	191.9	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	66.0	0	540,036
	Commercial Marine Vessels	Emission Fees	0.0	40.0	0	399,126
	Cement Manufacturing - Wet	SCR	0.0	265.6	0	1,070,720
	Motor Vehicles	California Reform	5,665.0	1,901.1	14,780,488	13,876,967
	Motor Vehicles	Enhanced I/M	4,898.2	4,022.1	1,624,627	3,249,253
	Motor Vehicles	California LEV	1,834.7	3,434.3	2,629,275	2,629,275
	Motor Vehicles	Reform Diesel	0.0	216.1	0	3,278,489
		Total	13,409.8	12,456.0	19,034,389	37,238,058
Chicago, IL	Open Burning	Episodic Ban	2,815.3	534.1	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	3,534.3	0.0	65,031,028	0
	Point Source Metal Surface Coating	FIP VOC Limits	7,008.5	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	78.8	0.0	1,971	0
	Point Sources	RE Improvements	9,297.3	0.0	18,594,560	0
	Bulk Terminals	RACT	156.2	0.0	260,239	0
	Metal product surface coating	VOC content limits & improved	3,668.8	0.0	128,230	0
	Wood product surface coating	Reformulation	26.6	0.0	682	0
	Wood furniture surface coating	Reformulation	1,275.3	0.0	1,590,807	0
	Adhesives - industrial	RACT	331.6	0.0	828,791	0
	Paper surface coating	Add-on control levels	40.3	0.0	3,027,556	0
	Miscellaneous surface coating	Add-on control levels	1,570.4	0.0	39,738,704	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	3,285.2	0.0	49,424,510	0
	Miscellaneous surface coating	MACT level of control	1,317.1	0.0	3,292,516	0
	Aerosols	SCAQMD Standards - Reformulati	2,458.6	0.0	15,363,210	0
	Aircraft surface coating	Add-on control levels	8.5	0.0	288,264	0
	marine surface coating	Add-on control levels	99.5	0.0	1,440,735	0
	Cutback Asphalt	Switch to emulsified asphalts	305.7	0.0	0	0
	Pharmaceutical manufacture	RACT	3.7	0.0	1,245	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	3,489.1	0.0	345,038	0
	Web Offset Lithography	New CTG (carbon adsorber)	36.2	0.0	-4,532	0
	Pesticide Application	Reformulation - FIP rule	479.6	0.0	4,459,519	0
	Recreational vehicles	CARB standards	1,404.9	0.0	744,518	0
	Motor Vehicles	California Reform	6,002.9	7,555.5	66,425,541	57,839,073
	Motor Vehicles	Enhanced I/M	1,994.0	1,579.0	630,296	1,260,592
	Motor Vehicles	California LEV	17,287.5	27,888.6	22,137,966	22,137,966
		Total	67,975.9	37,557.2	293,751,393	81,237,630

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
Cincinnati, OH	Open Burning	Episodic Ban	2,188.4	415.9	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	155.1	0.0	2,854,300	0
	Point Source Metal Surface Coating	FIP VOC Limits	455.9	0.0	0	0
	Point Sources	RE Improvements	10,748.2	0.0	21,496,310	0
	Bulk Terminals	RACT	250.8	0.0	417,687	0
	Metal product surface coating	VOC content limits & improved	258.8	0.0	7,644	0
	Wood product surface coating	Reformulation	9.7	0.0	269	0
	Wood furniture surface coating	Reformulation	1,122.3	0.0	471,160	0
	Adhesives - industrial	RACT	224.4	0.0	561,093	0
	Paper surface coating	Add-on control levels	45.4	0.0	3,068,288	0
	Miscellaneous surface coating	Add-on control levels	426.6	0.0	15,274,067	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	508.5	0.0	7,653,386	0
	Miscellaneous surface coating	MACT level of control	43.8	0.0	109,533	0
	Aerosols	SCAQMD Standards - Reformulati	594.4	0.0	3,715,980	0
	Aircraft surface coating	Add-on control levels	51.8	0.0	1,873,198	0
	marine surface coating	Add-on control levels	9.9	0.0	143,004	0
	SOCMI batch reactor processes	New CTG	107.4	0.0	435,460	0
	Cutback Asphalt	Switch to emulsified asphalts	233.3	0.0	0	0
	SOCMI fugitives	RACT	61.0	0.0	8,304	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,000.2	0.0	213,149	0
	Web Offset Lithography	New CTG (carbon adsorber)	32.9	0.0	-4,104	0
	Pesticide Application	Reformulation - FIP rule	192.6	0.0	1,788,800	0
	Recreational vehicles	CARB standards	225.3	0.0	119,227	0
	Motor Vehicles	California Reform	10,738.9	4,223.6	31,682,910	34,582,839
	Motor Vehicles	Enhanced I/M	12,538.1	9,488.4	1,129,634	2,259,268
	Motor Vehicles	California LEV	4,561.9	8,465.0	6,583,926	6,583,926
		Total	46,785.6	22,592.9	99,603,225	43,426,033
Columbia, SC	Utility Boiler - PC/Wall	SCR	0.0	12,643.7	0	43,437,417
	Utility Boiler - PC/Tangential	SCR	0.0	2,548.8	0	11,393,538
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	366.3	0	3,487,790
	Industrial Boiler - PC	SCR	0.0	2,458.5	0	19,157,697
	Industrial Boiler - Stoker	SCR	0.0	31.0	0	140,584
	Industrial Boiler - Residual Oil	SCR	0.0	42.6	0	123,972
	Industrial Boiler - Natural Gas	SCR	0.0	42.3	0	151,099
	Area Source Industrial Coal Comb	RACT to small sources	0.0	24.1	0	95,923
	Area Source Industrial Oil Comb	RACT to small sources	0.0	5.0	0	10,713
	Area Source Industrial NG Comb	RACT to small sources	0.0	55.8	0	93,301
	Open Burning	Episodic Ban	1,200.2	228.1	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	51.0	0	416,509
	Motor Vehicles	California Reform	4,004.7	1,285.1	10,104,174	9,465,335
	Motor Vehicles	Enhanced I/M	3,325.8	2,715.6	1,110,577	2,221,153

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Motor Vehicles	California LEV	1,200.7	2,343.7	1,797,255	1,797,255
		Total	9,731.4	24,841.6	13,012,006	91,992,286
Columbus, OH	Open Burning	Episodic Ban	1,441.5	274.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	201.1	0.0	5,028	0
	Point Sources	RE Improvements	2,207.8	0.0	4,415,770	0
	Bulk Terminals	RACT	124.2	0.0	206,804	0
	Metal product surface coating	VOC content limits & improved	240.7	0.0	6,010	0
	Wood product surface coating	Reformulation	14.0	0.0	343	0
	Wood furniture surface coating	Reformulation	385.4	0.0	144,484	0
	Adhesives - industrial	RACT	445.2	0.0	1,113,110	0
	Automobile refinishing	CARB BARCT limits	90.5	0.0	332,819	0
	Aerosols	CARB Tier 2 Standards - Reform	238.9	0.0	596,988	0
	Cutback Asphalt	Switch to emulsified asphalts	400.5	0.0	0	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	44.0	0.0	17,410	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,385.0	0.0	686,069	0
	Web Offset Lithography	New CTG (carbon adsorber)	235.1	0.0	-29,364	0
	Recreational vehicles	CARB standards	175.4	0.0	92,831	0
	Nonroad gasoline	Reformulated gasoline	122.8	0.0	614,000	0
	Motor Vehicles	Enhanced I/M	11,493.3	7,983.8	3,297,083	6,594,167
		Total	19,245.4	8,257.8	11,499,385	6,594,167
Dallas, TX	Open Burning	Episodic Ban	2,370.9	449.5	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	4,042.7	0.0	74,386,416	0
	Point Source Open Burning	Episodic Ban	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	204.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	208.0	0.0	5,202	0
	Point Sources	RE Improvements	14,125.2	0.0	28,250,270	0
	Bulk Terminals	RACT	1,175.5	0.0	1,958,930	0
	Metal product surface coating	VOC content limits & improved	1,515.7	0.0	50,164	0
	Wood product surface coating	Reformulation	25.4	0.0	1,114	0
	Wood furniture surface coating	Reformulation	760.9	0.0	611,283	0
	Adhesives - industrial	RACT	489.9	0.0	1,224,984	0
	Paper surface coating	Add-on control levels	108.3	0.0	6,534,254	0
	Miscellaneous surface coating	Add-on control levels	768.4	0.0	17,912,053	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	1,417.8	0.0	21,327,260	0
	Miscellaneous surface coating	MACT level of control	879.8	0.0	2,198,958	0
	Aerosols	SCAQMD Standards - Reformulati	1,240.0	0.0	7,750,320	0
	Aircraft surface coating	Add-on control levels	43.8	0.0	1,379,067	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	marine surface coating	Add-on control levels	74.8	0.0	1,082,729	0
	SOCMI batch reactor processes	New CTG	1.7	0.0	7,007	0
	Cutback Asphalt	Switch to emulsified asphalts	667.1	0.0	0	0
	Petroleum refinery fugitives	RACT	167.1	0.0	-75,186	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	118.2	0.0	46,827	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	3,128.7	0.0	1,060,077	0
	Web Offset Lithography	New CTG (carbon adsorber)	70.0	0.0	-8,747	0
	Pesticide Application	Reformulation - FIP rule	263.9	0.0	2,454,867	0
	Recreational vehicles	CARB standards	824.0	0.0	436,662	0
	Motor Vehicles	Federal Reform	6,747.7	1,030.4	18,082,811	0
	Motor Vehicles	Enhanced I/M	28,497.3	21,982.9	2,889,377	5,778,753
	Motor Vehicles	California LEV	10,664.3	19,720.7	15,451,183	15,451,183
		Total	80,601.1	43,183.5	205,017,882	21,229,936
Dayton, OH	Open Burning	Episodic Ban	1,106.0	210.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	321.6	0.0	0	0
	Point Sources	RE Improvements	1,072.8	0.0	2,145,470	0
	Bulk Terminals	RACT	109.1	0.0	181,719	0
	Metal product surface coating	VOC content limits & improved	135.6	0.0	3,387	0
	Wood product surface coating	Reformulation	3.2	0.0	81	0
	Wood furniture surface coating	Reformulation	230.9	0.0	86,569	0
	Adhesives - industrial	RACT	74.8	0.0	186,934	0
	Automobile refinishing	CARB BARCT limits	60.4	0.0	222,514	0
	Aerosols	CARB Tier 2 Standards - Reform	156.5	0.0	391,302	0
	Cutback Asphalt	Switch to emulsified asphalts	65.7	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	532.7	0.0	110,998	0
	Web Offset Lithography	New CTG (carbon adsorber)	4.2	0.0	-522	0
	Recreational vehicles	CARB standards	111.4	0.0	59,062	0
	Motor Vehicles	Federal Reform	5,472.4	1,065.6	17,400,892	0
	Motor Vehicles	Enhanced I/M	6,017.5	4,436.3	432,305	864,610
		Total	15,474.8	5,711.9	21,220,711	864,610
Detroit, MI	Open Burning	Episodic Ban	6,329.5	1,201.0	0	0
	Point Sources	RE Improvements	6,128.4	0.0	12,256,700	0
	Metal product surface coating	VOC content limits & improved	976.2	0.0	24,402	0
	Wood product surface coating	Reformulation	13.9	0.0	640	0
	Wood furniture surface coating	Reformulation	894.2	0.0	335,354	0
	Adhesives - industrial	RACT	679.9	0.0	1,699,437	0
	Paper surface coating	Add-on control levels	27.8	0.0	1,796,907	0
	Miscellaneous surface coating	Add-on control levels	335.9	0.0	16,961,559	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Automobile refinishing	FIP Rule (VOC Content & TE)	2,129.4	0.0	32,037,106	0
	Aerosols	SCAQMD Standards - Reformulati	1,427.2	0.0	8,920,140	0
	Aircraft surface coating	Add-on control levels	5.2	0.0	183,826	0
	marine surface coating	Add-on control levels	63.9	0.0	924,593	0
	SOCMI batch reactor processes	New CTG	45.3	0.0	183,544	0
	Cutback Asphalt	Switch to emulsified asphalts	585.6	0.0	0	0
	SOCMI fugitives	RACT	27.1	0.0	3,686	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	3.7	0.0	1,479	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	2,287.6	0.0	57,195	0
	Web Offset Lithography	New CTG (carbon adsorber)	57.5	0.0	-7,198	0
	Pesticide Application	Reformulation - FIP rule	174.0	0.0	1,617,418	0
	Recreational vehicles	CARB standards	927.1	0.0	491,288	0
	Motor Vehicles	California Reform	32,663.3	11,304.7	93,144,598	87,262,066
	Motor Vehicles	Enhanced I/M	32,251.6	23,427.6	2,745,095	5,490,191
	Motor Vehicles	California LEV	12,421.1	21,058.8	16,672,043	16,672,043
		Total	100,455.4	56,992.1	190,049,812	109,424,300
Dover, DE	Open Burning	Episodic Ban	736.8	139.6	0	0
	Point Sources	RE Improvements	474.5	0.0	949,000	0
	Metal product surface coating	VOC content limits & improved	197.7	0.0	4,898	0
	Wood furniture surface coating	Reformulation	233.9	0.0	87,742	0
	Paper surface coating	Add-on control levels	3.3	0.0	218,263	0
	Miscellaneous surface coating	Add-on control levels	47.3	0.0	845,535	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	114.3	0.0	1,719,832	0
	Miscellaneous surface coating	MACT level of control	29.5	0.0	73,707	0
	Aerosols	SCAQMD Standards - Reformulati	88.6	0.0	553,440	0
	marine surface coating	Add-on control levels	14.0	0.0	202,774	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	130.3	0.0	3,272	0
	Pesticide Application	Reformulation - FIP rule	102.4	0.0	952,097	0
	Recreational vehicles	CARB standards	42.6	0.0	22,630	0
	Motor Vehicles	California Reform	815.2	718.7	2,110,658	8,316,929
	Motor Vehicles	Enhanced I/M	1,792.2	1,540.1	616,934	1,233,867
	Motor Vehicles	California LEV	920.9	1,996.9	1,560,627	1,560,627
		Total	5,743.5	4,395.3	9,921,409	11,111,423
Eugene, OR	Adhesives - industrial	RACT	398.9	0.0	997,164	0
	Aerosols	CARB Tier 2 Standards - Reform	67.3	0.0	168,276	0
	Automobile refinishing	CARB BARCT limits	27.4	0.0	100,653	0
	Bulk Terminals	RACT	173.6	0.0	289,200	0
	Cutback Asphalt	Switch to emulsified asphalts	351.5	0.0	0	0
	Metal product surface coating	VOC content limits & improved	92.8	0.0	2,314	0
	Miscellaneous surface coating	MACT level of control	49.2	0.0	122,853	0
	Motor Vehicles	Enhanced I/M	2,659.9	2,365.1	951,535	1,903,069

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Nonroad gasoline	Reformulated gasoline	34.8	0.0	174,000	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	1.2	0.0	470	0
	Open Burning	Episodic Ban	473.9	89.9	0	0
	Recreational vehicles	CARB standards	75.8	0.0	40,095	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	358.9	0.0	186,182	0
	Web Offset Lithography	New CTG (carbon adsorber)	67.6	0.0	-8,447	0
	Wood furniture surface coating	Reformulation	114.8	0.0	43,029	0
	Wood product surface coating	Reformulation	58.6	0.0	1,464	0
		Total	5,006.2	2,455.0	3,068,788	1,903,069
Evansville, IN	Open Burning	Episodic Ban	498.6	94.5	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	599.3	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	2,017.4	0.0	50,434	0
	Point Sources	RE Improvements	2.6	0.0	5,110	0
	Bulk Terminals	RACT	447.5	0.0	745,502	0
	Metal product surface coating	VOC content limits & improved	155.1	0.0	4,227	0
	Wood product surface coating	Reformulation	1.7	0.0	42	0
	Wood furniture surface coating	Reformulation	129.4	0.0	69,798	0
	Adhesives - industrial	RACT	247.0	0.0	617,312	0
	Automobile refinishing	CARB BARCT limits	32.4	0.0	119,310	0
	Miscellaneous surface coating	MACT level of control	56.4	0.0	140,911	0
	Aerosols	CARB Tier 2 Standards - Reform	53.4	0.0	133,488	0
	Cutback Asphalt	Switch to emulsified asphalts	182.6	0.0	0	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	27.0	0.0	10,690	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	306.4	0.0	155,344	0
	Web Offset Lithography	New CTG (carbon adsorber)	80.3	0.0	-10,032	0
	Recreational vehicles	CARB standards	48.9	0.0	25,847	0
	Nonroad gasoline	Reformulated gasoline	29.1	0.0	145,500	0
	Motor Vehicles	Enhanced I/M	2,588.9	1,830.5	736,854	1,473,708
		Total	7,504.0	1,925.0	2,950,337	1,473,708
Fresno, CA	Adhesives - industrial	RACT	14.2	0.0	35,444	0
	Aerosols	CARB Tier 2 Standards - Reform	119.6	0.0	298,638	0
	Aerosols	SCAQMD Standards - Reformulati	119.6	0.0	1,194,552	0
	Automobile refinishing	CARB BARCT limits	58.9	0.0	217,170	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	225.5	0.0	4,062,635	0
	Bulk Terminals	RACT	57.2	0.0	95,380	0
	Cutback Asphalt	Switch to emulsified asphalts	57.0	0.0	0	0
	marine surface coating	Add-on control levels	11.1	0.0	160,048	0
	Metal product surface coating	VOC content limits & improved	77.5	0.0	1,931	0
	Miscellaneous surface coating	Add-on control levels	93.6	0.0	1,460,681	0
	Miscellaneous surface coating	MACT level of control	27.8	0.0	69,321	0
	Motor Vehicles	Enhanced I/M	750.9	1,264.0	298,651	597,301

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Nonroad gasoline	Reformulated gasoline	63.0	0.0	315,000	0
	Open Burning	Episodic Ban	276.4	52.4	0	0
	Paper surface coating	Add-on control levels	4.5	0.0	298,193	0
	Pesticide Application	Reformulation - FIP rule	742.3	0.0	6,903,465	0
	Point Source Metal Surface Coating	FIP VOC Limits	52.6	0.0	0	0
	Point Sources	RE Improvements	3,519.3	0.0	7,038,660	0
	Recreational vehicles	CARB standards	60.8	0.0	32,225	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	454.2	0.0	103,431	0
	Web Offset Lithography	New CTG (carbon adsorber)	4.1	0.0	-508	0
	Wood furniture surface coating	Reformulation	102.1	0.0	38,279	0
	Wood product surface coating	Reformulation	6.2	0.0	154	0
		Total	6,898.4	1,316.4	22,623,350	597,301
Gadsden, AL	Utility Boiler - PC/Tangential	SCR	0.0	644.2	0	7,221,513
	Industrial Boiler - Residual Oil	SCR	0.0	22.2	0	63,390
	Industrial Boiler - Natural Gas	SCR	0.0	741.0	0	2,676,647
	Area Source Industrial Coal Comb	RACT to small sources	0.0	5.6	0	21,983
	Area Source Industrial Oil Comb	RACT to small sources	0.0	1.6	0	3,332
	Area Source Industrial NG Comb	RACT to small sources	0.0	68.6	0	115,813
	Open Burning	Episodic Ban	319.1	60.8	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	18.1	0	148,361
	Iron & Steel Mills - Reheating	LNB + FGR	0.0	282.8	0	145,027
	Motor Vehicles	California Reform	1,658.7	545.3	4,214,478	3,961,791
	Motor Vehicles	Enhanced I/M	1,406.0	1,143.7	462,235	924,471
	Motor Vehicles	California LEV	513.5	977.1	748,129	748,129
	Motor Vehicles	Reform Diesel	0.0	67.3	0	1,033,553
		Total	3,897.3	4,578.3	5,424,842	17,064,009
Grand Rapids, MI	Open Burning	Episodic Ban	924.5	175.4	0	0
	Point Sources	RE Improvements	6,025.1	0.0	12,050,110	0
	Metal product surface coating	VOC content limits & improved	218.1	0.0	5,456	0
	Wood product surface coating	Reformulation	6.5	0.0	298	0
	Wood furniture surface coating	Reformulation	5,407.2	0.0	2,027,744	0
	Adhesives - industrial	RACT	245.9	0.0	614,665	0
	Paper surface coating	Add-on control levels	32.8	0.0	2,069,547	0
	Miscellaneous surface coating	Add-on control levels	1,539.4	0.0	38,461,773	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	387.4	0.0	5,829,631	0
	Aerosols	SCAQMD Standards - Reformulati	294.4	0.0	1,838,700	0
	Aircraft surface coating	Add-on control levels	5.6	0.0	200,467	0
	marine surface coating	Add-on control levels	68.1	0.0	985,510	0
	Cutback Asphalt	Switch to emulsified asphalts	244.3	0.0	0	0
	Pharmaceutical manufacture	RACT	138.2	0.0	46,285	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	37.7	0.0	14,970	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	403.3	0.0	10,082	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Web Offset Lithography	New CTG (carbon adsorber)	18.7	0.0	-2,341	0
	Pesticide Application	Reformulation - FIP rule	128.0	0.0	1,189,470	0
	Recreational vehicles	CARB standards	777.1	0.0	411,888	0
	Motor Vehicles	California Reform	6,672.3	2,634.1	21,071,730	19,487,874
	Motor Vehicles	Enhanced I/M	6,676.3	5,413.5	846,421	1,692,841
	Motor Vehicles	California LEV	2,497.1	4,758.5	3,690,850	3,690,850
		Total	32,748.0	12,981.5	91,363,256	24,871,565
Green Bay, WI	Open Burning	Episodic Ban	385.8	73.1	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	104.4	0.0	1,920,776	0
	Point Source Metal Surface Coating	FIP VOC Limits	16.4	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	17.9	0.0	447	0
	Metal product surface coating	VOC content limits & improved	112.8	0.0	4,425	0
	Wood product surface coating	Reformulation	3.9	0.0	171	0
	Wood furniture surface coating	Reformulation	185.1	0.0	142,522	0
	Adhesives - industrial	RACT	281.1	0.0	702,740	0
	Paper surface coating	Add-on control levels	38.5	0.0	3,952,517	0
	Miscellaneous surface coating	Add-on control levels	56.0	0.0	1,903,772	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	110.3	0.0	1,659,932	0
	Miscellaneous surface coating	MACT level of control	108.7	0.0	271,727	0
	Aerosols	SCAQMD Standards - Reformulati	97.4	0.0	608,130	0
	marine surface coating	Add-on control levels	261.1	0.0	3,778,474	0
	SOCMI batch reactor processes	New CTG	1.7	0.0	6,931	0
	Cutback Asphalt	Switch to emulsified asphalts	176.5	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	123.4	0.0	3,091	0
	Web Offset Lithography	New CTG (carbon adsorber)	2.5	0.0	-312	0
	Pesticide Application	Reformulation - FIP rule	50.2	0.0	466,507	0
	Recreational vehicles	CARB standards	104.0	0.0	55,132	0
	Motor Vehicles	California Reform	1,902.8	789.5	6,331,524	5,874,730
	Motor Vehicles	Enhanced I/M	2,203.0	1,639.3	513,145	1,026,289
	Motor Vehicles	California LEV	786.2	1,416.2	1,114,158	1,114,158
		Total	7,129.7	3,918.1	23,435,808	8,015,177
Greensboro, NC	Utility Boiler - PC/Wall	SCR	0.0	17,957.6	0	57,665,046
	Utility Boiler - PC/Tangential	SCR	0.0	1,165.3	0	12,725,521
	Industrial Boiler - PC	SCR	0.0	88.6	0	1,859,550
	Industrial Boiler - Stoker	SCR	0.0	233.8	0	1,771,700
	Industrial Boiler - Residual Oil	SCR	0.0	604.4	0	2,445,920
	Industrial Boiler - Natural Gas	SCR	0.0	4.6	0	38,686
	Area Source Industrial Coal Comb	RACT to small sources	0.0	157.9	0	630,344
	Area Source Industrial Oil Comb	RACT to small sources	0.0	12.7	0	27,933
	Area Source Industrial NG Comb	RACT to small sources	0.0	158.7	0	266,136
	Open Burning	Episodic Ban	2,245.0	425.2	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	125.5	0	1,022,860

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Cogeneration - Coal	SCR	0.0	991.3	0	9,199,840
	Motor Vehicles	California Reform	8,488.8	3,395.3	27,632,246	25,932,237
	Motor Vehicles	Enhanced I/M	8,319.7	7,158.9	1,431,332	2,862,664
	Motor Vehicles	California LEV	3,432.1	6,284.5	4,919,313	4,919,313
	Motor Vehicles	Reform Diesel	0.0	396.7	0	5,890,406
		Total	22,485.6	39,161.0	33,982,891	127,258,156
Harrisburg, PA	Open Burning	Episodic Ban	750.9	142.4	0	0
	Metal product surface coating	VOC content limits & improved	96.4	0.0	2,407	0
	Wood product surface coating	Reformulation	5.8	0.0	144	0
	Wood furniture surface coating	Reformulation	26.1	0.0	26,756	0
	Paper surface coating	Add-on control levels	11.1	0.0	748,944	0
	Miscellaneous surface coating	Add-on control levels	36.7	0.0	2,502,769	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	165.8	0.0	2,492,928	0
	Aerosols	SCAQMD Standards - Reformulati	167.9	0.0	1,049,280	0
	Aircraft surface coating	Add-on control levels	3.3	0.0	117,525	0
	marine surface coating	Add-on control levels	2.0	0.0	28,661	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	302.3	0.0	7,557	0
	Pesticide Application	Reformulation - FIP rule	46.3	0.0	429,883	0
	Recreational vehicles	CARB standards	69.5	0.0	36,896	0
	Motor Vehicles	California Reform	392.7	715.2	227,500	10,522,263
	Motor Vehicles	Enhanced I/M	283.3	233.7	88,688	177,377
	Motor Vehicles	California LEV	1,367.2	2,598.7	1,995,763	1,995,763
		Total	3,727.3	3,690.0	9,755,701	12,695,403
Hartford, CT	Open Burning	Episodic Ban	890.4	168.9	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	5.8	0.0	107,456	0
	Point Source Metal Surface Coating	FIP VOC Limits	102.9	0.0	0	0
	Metal product surface coating	VOC content limits & improved	90.3	0.0	12,139	0
	Wood product surface coating	Reformulation	4.7	0.0	116	0
	Wood furniture surface coating	Reformulation	46.7	0.0	74,532	0
	Paper surface coating	Add-on control levels	13.7	0.0	1,374,240	0
	Miscellaneous surface coating	Add-on control levels	43.6	0.0	3,164,929	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	269.8	0.0	7,859,989	0
	Aerosols	SCAQMD Standards - Reformulati	276.6	0.0	1,728,300	0
	Aircraft surface coating	Add-on control levels	115.6	0.0	6,053,206	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	467.5	0.0	11,687	0
	Pesticide Application	Reformulation - FIP rule	12.5	0.0	115,841	0
	Recreational vehicles	CARB standards	296.1	0.0	156,879	0
	Motor Vehicles	California Reform	710.1	1,313.5	486,500	19,984,065
	Motor Vehicles	California LEV	2,649.3	4,889.5	3,811,174	3,811,174
		Total	5,995.6	6,371.9	24,956,988	23,795,239
Houston, TX	Open Burning	Episodic Ban	118.0	22.1	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	85.0	0.0	1,564,828	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	62.8	0.0	1,570	0
	Point Sources	RE Improvements	1,468.8	0.0	2,937,520	0
	Bulk Terminals	RACT	463.9	0.0	773,103	0
	Metal product surface coating	VOC content limits & improved	12.9	0.0	321	0
	Wood product surface coating	Reformulation	9.7	0.0	242	0
	Wood furniture surface coating	Reformulation	12.1	0.0	4,536	0
	Adhesives - industrial	RACT	54.9	0.0	137,302	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	2.6	0.0	46,902	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	31.6	0.0	476,588	0
	Miscellaneous surface coating	MACT level of control	3.3	0.0	8,222	0
	Aerosols	SCAQMD Standards - Reformulati	61.1	0.0	383,160	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	SOCMI batch reactor processes	New CTG	217.0	0.0	879,774	0
	Cutback Asphalt	Switch to emulsified asphalts	193.4	0.0	0	0
	SOCMI fugitives	RACT	130.6	0.0	17,792	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	12.4	0.0	4,910	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	389.8	0.0	292,007	0
	Web Offset Lithography	New CTG (carbon adsorber)	16.2	0.0	-2,028	0
	Pesticide Application	Reformulation - FIP rule	149.0	0.0	1,384,808	0
	Recreational vehicles	CARB standards	36.8	0.0	19,476	0
	Motor Vehicles	Federal Reform	2,364.8	311.5	7,043,832	0
	Motor Vehicles	Enhanced I/M	1,568.9	1,345.3	519,516	1,039,032
	Motor Vehicles	California LEV	495.8	1,129.5	840,930	840,930
		Total	7,961.4	2,808.4	17,335,311	1,879,962
Huntington, WV	Open Burning	Episodic Ban	677.8	128.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	106.2	0.0	1,954,356	0
	Point Sources	RE Improvements	6,281.0	0.0	12,561,840	0
	Bulk Terminals	RACT	312.3	0.0	520,139	0
	Metal product surface coating	VOC content limits & improved	60.4	0.0	2,175	0
	Wood furniture surface coating	Reformulation	47.7	0.0	18,348	0
	Adhesives - industrial	RACT	123.4	0.0	308,284	0
	Miscellaneous surface coating	Add-on control levels	27.2	0.0	984,745	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	83.8	0.0	1,259,957	0
	Miscellaneous surface coating	MACT level of control	13.7	0.0	34,223	0
	Aerosols	SCAQMD Standards - Reformulati	172.5	0.0	1,075,530	0
	marine surface coating	Add-on control levels	5.7	0.0	82,393	0
	SOCMI batch reactor processes	New CTG	105.1	0.0	426,152	0
	Cutback Asphalt	Switch to emulsified asphalts	274.0	0.0	0	0
	SOCMI fugitives	RACT	61.3	0.0	8,345	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Oil and natural gas production fiel	RACT (equipment/maintenance)	12.8	0.0	5,039	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	597.4	0.0	345,603	0
	Web Offset Lithography	New CTG (carbon adsorber)	18.2	0.0	-2,290	0
	Pesticide Application	Reformulation - FIP rule	23.2	0.0	215,388	0
	Recreational vehicles	CARB standards	59.0	0.0	31,170	0
	Motor Vehicles	California Reform	2,852.2	1,338.1	10,278,759	9,645,697
	Motor Vehicles	Enhanced I/M	3,340.0	2,779.3	747,441	1,494,881
	Motor Vehicles	California LEV	1,154.5	2,393.5	1,818,804	1,818,804
		Total	16,409.4	6,638.9	32,676,401	12,959,382
Indianapolis, IN	Open Burning	Episodic Ban	2,063.1	391.5	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	28.1	0.0	0	0
	Point Sources	RE Improvements	3,550.0	0.0	7,099,980	0
	Bulk Terminals	RACT	1,343.1	0.0	2,237,728	0
	Metal product surface coating	VOC content limits & improved	497.2	0.0	17,521	0
	Wood product surface coating	Reformulation	13.0	0.0	430	0
	Wood furniture surface coating	Reformulation	738.2	0.0	541,637	0
	Adhesives - industrial	RACT	681.3	0.0	1,703,266	0
	Automobile refinishing	CARB BARCT limits	104.3	0.0	383,634	0
	Miscellaneous surface coating	MACT level of control	311.2	0.0	778,066	0
	Aerosols	CARB Tier 2 Standards - Reform	219.3	0.0	548,148	0
	Cutback Asphalt	Switch to emulsified asphalts	694.0	0.0	0	0
	Pharmaceutical manufacture	RACT	46.7	0.0	15,664	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	2,126.1	0.0	1,290,026	0
	Web Offset Lithography	New CTG (carbon adsorber)	253.7	0.0	-31,718	0
	Recreational vehicles	CARB standards	208.9	0.0	110,710	0
	Motor Vehicles	Enhanced I/M	12,258.3	8,426.4	3,494,813	6,989,625
		Total	25,136.5	8,817.9	18,189,905	6,989,625
Johnson City, TN	Utility Boiler - PC/Wall	SCR	0.0	24,187.3	0	81,013,209
	Utility Boiler - PC/Tangential	SCR	0.0	8,176.7	0	30,541,085
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	915.8	0	6,975,580
	Industrial Boiler - Cyclone	NGR	0.0	13.1	0	162,580
	Industrial Boiler - PC	SCR	0.0	15,515.4	0	119,291,243
	Industrial Boiler - Stoker	SCR	0.0	5,334.9	0	23,531,608
	Industrial Boiler - Residual Oil	SCR	0.0	87.2	0	252,888
	Industrial Boiler - Distillate Oil	SCR	0.0	50.6	0	241,946
	Industrial Boiler - Natural Gas	SCR	0.0	51.8	0	189,219
	IC Engines - Natural Gas	NSCR	0.0	812.7	0	144,518
	Gas Turbines - Natural Gas	SCR + STEAM INJECTION	0.0	17.5	0	126,036
	Process Heaters - Natural Gas	LNB + SCR	0.0	0.1	0	1,876
	Nitric Acid Manufacturing Plant	NSCR	0.0	25.8	0	215,939
	Area Source Industrial Coal Comb	RACT to small sources	0.0	26.8	0	105,786

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Area Source Industrial Oil Comb	RACT to small sources	0.0	2.6	0	5,374
	Area Source Industrial NG Comb	RACT to small sources	0.0	32.8	0	54,795
	Open Burning	Episodic Ban	1,585.5	300.9	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	56.5	0	461,591
	Commercial Marine Vessels	Emission Fees	0.0	24.4	0	243,554
	Glass Manufacturing - Container	Oxy-Firing	0.0	135.2	0	857,196
	Motor Vehicles	California Reform	5,060.2	1,933.2	14,094,503	14,220,239
	Motor Vehicles	Enhanced I/M	4,710.6	4,202.5	1,656,671	3,313,342
	Motor Vehicles	California LEV	1,714.3	3,558.2	2,681,437	2,681,437
	Motor Vehicles	Reform Diesel	0.0	251.4	0	3,900,308
		Total	13,070.6	65,713.4	18,432,611	288,531,349
Knoxville, TN	Utility Boiler - PC/Wall	SCR	0.0	5,998.5	0	18,742,279
	Utility Boiler - PC/Tangential	SCR	0.0	8,106.7	0	26,025,212
	Industrial Boiler - PC	SCR	0.0	1,326.8	0	10,426,112
	Industrial Boiler - Stoker	SCR	0.0	839.0	0	4,058,426
	Industrial Boiler - Residual Oil	SCR	0.0	56.3	0	200,607
	Industrial Boiler - Distillate Oil	LNB	0.0	4.1	0	5,856
	Industrial Boiler - Natural Gas	SCR	0.0	57.5	0	207,217
	Process Heaters - Natural Gas	LNB + SCR	0.0	73.6	0	344,618
	Area Source Industrial Coal Comb	RACT to small sources	0.0	38.4	0	147,350
	Area Source Industrial Oil Comb	RACT to small sources	0.0	2.8	0	5,962
	Area Source Industrial NG Comb	RACT to small sources	0.0	39.0	0	61,946
	Open Burning	Episodic Ban	1,281.6	242.8	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	85.0	0	694,198
	Commercial Marine Vessels	Emission Fees	0.0	57.6	0	575,089
	Cement Manufacturing - Dry	SCR	0.0	841.3	0	4,064,979
	Motor Vehicles	California Reform	12,632.6	3,713.8	38,361,908	18,059,394
	Motor Vehicles	Enhanced I/M	6,375.2	5,293.0	2,109,902	4,219,805
	Motor Vehicles	California LEV	2,210.2	4,496.3	3,414,811	3,414,811
	Motor Vehicles	Reform Diesel	0.0	301.1	0	4,554,860
		Total	22,499.6	31,573.6	43,886,621	95,808,720
Los Angeles, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Louisville, KY	Open Burning	Episodic Ban	1,928.7	365.7	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	2,629.9	0.0	48,388,780	0
	Point Source Metal Surface Coating	FIP VOC Limits	287.3	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	39.4	0.0	986	0
	Point Sources	RE Improvements	945.0	0.0	1,889,970	0
	Bulk Terminals	RACT	138.5	0.0	230,461	0
	Metal product surface coating	VOC content limits & improved	345.8	0.0	14,845	0
	Wood product surface coating	Reformulation	9.4	0.0	563	0
	Wood furniture surface coating	Reformulation	834.0	0.0	397,989	0
	Adhesives - industrial	RACT	194.0	0.0	484,559	0
	Paper surface coating	Add-on control levels	19.3	0.0	490,293	0
	Miscellaneous surface coating	Add-on control levels	1,166.3	0.0	20,744,738	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	397.0	0.0	5,970,802	0
	Miscellaneous surface coating	MACT level of control	110.2	0.0	275,106	0
	Aerosols	SCAQMD Standards - Reformulati	366.8	0.0	2,290,320	0
	marine surface coating	Add-on control levels	34.1	0.0	494,512	0
	Cutback Asphalt	Switch to emulsified asphalts	227.1	0.0	0	0
	Petroleum refinery fugitives	RACT	52.5	0.0	-23,622	0
	Pharmaceutical manufacture	RACT	20.3	0.0	6,790	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	799.0	0.0	262,474	0
	Web Offset Lithography	New CTG (carbon adsorber)	21.0	0.0	-2,636	0
	Pesticide Application	Reformulation - FIP rule	117.1	0.0	1,089,365	0
	Recreational vehicles	CARB standards	155.5	0.0	82,423	0
	Motor Vehicles	California Reform	3,164.9	2,014.5	9,141,402	21,741,142
	Motor Vehicles	Enhanced I/M	8,160.4	6,004.6	900,516	1,801,031
	Motor Vehicles	California LEV	2,911.5	5,310.9	4,134,846	4,134,846
		Total	25,075.0	13,695.7	97,265,482	27,677,019
Macon, GA	Utility Boiler - PC/Wall	SCR	0.0	28,812.3	0	98,504,407
	Industrial Boiler - PC	SCR	0.0	752.3	0	5,922,003
	Industrial Boiler - Stoker	SCR	0.0	160.3	0	723,909

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
	Industrial Boiler - Residual Oil	SCR	0.0	294.5	0	859,704
	Industrial Boiler - Distillate Oil	SCR	0.0	12.4	0	58,747
	Industrial Boiler - Natural Gas	SCR	0.0	891.5	0	3,188,713
	Area Source Industrial NG Comb	RACT to small sources	0.0	47.4	0	81,530
	Open Burning	Episodic Ban	856.6	162.6	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	46.7	0	381,506
	Glass Manufacturing - Container	Oxy-Firing	0.0	42.5	0	266,848
	Cement Manufacturing - Dry	SCR	0.0	493.1	0	2,359,895
	Cement Manufacturing - Wet	SCR	0.0	419.6	0	1,675,408
	Motor Vehicles	California Reform	3,727.4	1,285.2	10,062,131	9,445,702
	Motor Vehicles	Enhanced I/M	3,339.9	2,733.4	1,106,025	2,212,049
	Motor Vehicles	California LEV	1,253.7	2,329.5	1,789,979	1,789,979
	Motor Vehicles	Reform Diesel	0.0	155.6	0	2,222,513
		Total	9,177.6	38,638.9	12,958,135	129,692,913
Memphis, TN	Utility Boiler - Cyclone	SCR	0.0	5,531.8	0	88,425,740
	Industrial Boiler - Stoker	SCR	0.0	155.8	0	1,572,925
	Industrial Boiler - Residual Oil	SCR	0.0	60.7	0	403,127
	Industrial Boiler - Distillate Oil	SCR	0.0	34.8	0	364,499
	Industrial Boiler - Natural Gas	SCR	0.0	514.5	0	4,231,577
	IC Engines - Natural Gas	NSCR	0.0	1,386.6	0	237,702
	IC Engines - Oil	SCR	0.0	825.8	0	324,265
	Gas Turbines - Natural Gas	SCR + STEAM INJECTION	0.0	71.4	0	1,242,784
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	99.9	0	786,261
	Process Heaters - Natural Gas	LNB + SCR	0.0	77.2	0	733,581
	Process Heaters - Distillate Oil	LNB + SCR	0.0	98.5	0	3,459,895
	Area Source Industrial Coal Comb	RACT to small sources	0.0	218.2	0	849,906
	Area Source Industrial Oil Comb	RACT to small sources	0.0	19.4	0	31,018
	Area Source Industrial NG Comb	RACT to small sources	0.0	102.0	0	176,219
	Open Burning	Episodic Ban	566.3	107.1	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	115.1	0	935,762
	Commercial Marine Vessels	Emission Fees	0.0	538.3	0	5,382,359
	Point Source Ind. Surface Coating	Add-on Control Levels	340.1	0.0	6,259,312	0
	Point Source Metal Surface Coating	FIP VOC Limits	16.8	0.0	0	0
	Point Sources	RE Improvements	4,609.6	0.0	9,219,170	0
	Bulk Terminals	RACT	194.0	0.0	323,258	0
	Metal product surface coating	VOC content limits & improved	530.4	0.0	17,475	0
	Wood product surface coating	Reformulation	5.4	0.0	308	0
	Wood furniture surface coating	Reformulation	1,227.9	0.0	460,432	0
	Adhesives - industrial	RACT	204.0	0.0	510,073	0
	Paper surface coating	Add-on control levels	57.4	0.0	2,411,152	0
	Miscellaneous surface coating	Add-on control levels	375.9	0.0	8,933,296	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	328.1	0.0	4,933,164	0
	Miscellaneous surface coating	MACT level of control	54.4	0.0	135,950	0
	Aerosols	SCAQMD Standards - Reformulati	346.2	0.0	2,162,760	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	marine surface coating	Add-on control levels	3.8	0.0	54,648	0
	Cutback Asphalt	Switch to emulsified asphalts	180.2	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,349.3	0.0	665,608	0
	Web Offset Lithography	New CTG (carbon adsorber)	222.0	0.0	-27,756	0
	Pesticide Application	Reformulation - FIP rule	181.5	0.0	1,687,689	0
	Recreational vehicles	CARB standards	116.3	0.0	61,551	0
	Motor Vehicles	Federal Reform	6,090.8	1,125.8	18,444,455	0
	Motor Vehicles	Enhanced I/M	6,145.1	4,641.7	711,062	1,422,123
	Motor Vehicles	California LEV	2,500.4	4,153.0	3,287,891	3,287,891
	Motor Vehicles	Reform Diesel	0.0	216.0	0	3,044,678
		Total	25,645.9	20,093.6	60,251,498	116,912,312
Milwaukee, WI	Open Burning	Episodic Ban	2,714.9	516.3	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	439.4	0.0	8,086,064	0
	Point Source Metal Surface Coating	FIP VOC Limits	1,256.7	0.0	0	0
	Point Sources	RE Improvements	514.3	0.0	1,028,570	0
	Metal product surface coating	VOC content limits & improved	382.3	0.0	13,833	0
	Wood product surface coating	Reformulation	5.5	0.0	217	0
	Wood furniture surface coating	Reformulation	221.1	0.0	129,870	0
	Paper surface coating	Add-on control levels	7.2	0.0	739,470	0
	Miscellaneous surface coating	Add-on control levels	1,012.5	0.0	17,495,889	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	490.3	0.0	7,376,398	0
	Miscellaneous surface coating	MACT level of control	865.9	0.0	2,164,630	0
	Aerosols	SCAQMD Standards - Reformulati	478.6	0.0	2,990,580	0
	marine surface coating	Add-on control levels	2.1	0.0	29,350	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	633.6	0.0	15,856	0
	Pesticide Application	Reformulation - FIP rule	48.4	0.0	449,636	0
	Recreational vehicles	CARB standards	355.2	0.0	188,175	0
	Motor Vehicles	California Reform	989.9	1,795.1	681,500	27,848,003
	Motor Vehicles	California LEV	4,186.4	6,698.7	5,323,070	5,323,070
		Total	14,604.3	9,010.1	46,713,108	33,171,073
Mobile, AL	Open Burning	Episodic Ban	630.5	119.8	0	0
	Point Sources	RE Improvements	21,973.0	0.0	43,946,000	0
	Metal product surface coating	VOC content limits & improved	93.0	0.0	4,150	0
	Wood product surface coating	Reformulation	3.9	0.0	250	0
	Wood furniture surface coating	Reformulation	55.5	0.0	79,862	0
	Cutback Asphalt	Switch to emulsified asphalts	429.4	0.0	0	0
	SOCMI fugitives	RACT	389.2	0.0	53,028	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	100.8	0.0	39,986	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	293.7	0.0	7,343	0
	Web Offset Lithography	New CTG (carbon adsorber)	39.8	0.0	-4,975	0
	Recreational vehicles	CARB standards	29.7	0.0	15,721	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Motor Vehicles	Enhanced I/M	3,265.6	2,481.9	1,032,990	2,065,981
		Total	27,304.1	2,601.7	45,174,355	2,065,981
Modesto, CA	Aerosols	CARB Tier 2 Standards - Reform	46.7	0.0	116,760	0
	Aerosols	SCAQMD Standards - Reformulati	46.7	0.0	467,040	0
	Automobile refinishing	CARB BARCT limits	30.0	0.0	110,381	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	114.6	0.0	2,064,926	0
	Metal product surface coating	VOC content limits & improved	352.8	0.0	8,725	0
	Miscellaneous surface coating	Add-on control levels	64.2	0.0	1,006,908	0
	Miscellaneous surface coating	MACT level of control	17.1	0.0	42,760	0
	Nonroad gasoline	Reformulated gasoline	25.1	0.0	125,500	0
	Open Burning	Episodic Ban	97.6	18.5	0	0
	Paper surface coating	Add-on control levels	9.4	0.0	632,619	0
	Pesticide Application	Reformulation - FIP rule	108.9	0.0	1,012,621	0
	Point Source Ind. Surface Coating	Add-on Control Levels	74.1	0.0	1,363,348	0
	Point Source Metal Surface Coating	FIP VOC Limits	61.0	0.0	0	0
	Recreational vehicles	CARB standards	24.4	0.0	12,907	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	131.9	0.0	3,297	0
	Wood furniture surface coating	Reformulation	78.4	0.0	29,408	0
	Wood product surface coating	Reformulation	2.5	0.0	63	0
		Total	1,285.4	18.5	6,997,263	0
Nashville, TN	Utility Boiler - PC/Tangential	SCR	0.0	10,608.4	0	38,924,513
	Industrial Boiler - PC	SCR	0.0	411.4	0	6,261,012
	Industrial Boiler - Stoker	SCR	0.0	39.7	0	413,030
	Industrial Boiler - Residual Oil	SCR	0.0	19.5	0	78,816
	Industrial Boiler - Distillate Oil	SCR	0.0	20.3	0	218,482
	Industrial Boiler - Natural Gas	SCR	0.0	244.8	0	1,910,614
	IC Engines - Natural Gas	NSCR	0.0	3,659.7	0	2,591,036
	Gas Turbines - Natural Gas	SCR + STEAM INJECTION	0.0	316.2	0	2,596,960
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	246.5	0	5,652,452
	Process Heaters - Natural Gas	LNB + SCR	0.0	11.3	0	174,243
	Area Source Industrial Coal Comb	RACT to small sources	0.0	110.2	0	417,861
	Area Source Industrial Oil Comb	RACT to small sources	0.0	9.9	0	20,524
	Area Source Industrial NG Comb	RACT to small sources	0.0	151.8	0	240,219
	Open Burning	Episodic Ban	1,064.9	201.5	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	118.2	0	963,791
	Commercial Marine Vessels	Emission Fees	0.0	27.6	0	274,516
	Municipal Waste Combustors	SNCR	0.0	131.6	0	439,269
	Motor Vehicles	California Reform	7,291.5	2,984.6	24,637,770	23,108,747
	Motor Vehicles	Enhanced I/M	7,689.3	6,365.8	912,070	1,824,139
	Motor Vehicles	California LEV	3,095.6	5,647.0	4,396,974	4,396,974
	Motor Vehicles	Reform Diesel	0.0	318.7	0	4,709,895
		Total	19,141.3	31,644.7	29,946,814	95,217,093

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
New London, CT	Open Burning	Episodic Ban	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Motor Vehicles	California LEV	0.0	0.0	0	0
		Total	0.0	0.0	0	0
New Orleans, LA	Open Burning	Episodic Ban	1,225.0	232.5	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	418.7	0.0	7,703,252	0
	Point Source Metal Surface Coating	FIP VOC Limits	20.4	0.0	0	0
	Point Sources	RE Improvements	1,977.9	0.0	3,955,870	0
	Metal product surface coating	VOC content limits & improved	300.2	0.0	10,860	0
	Wood product surface coating	Reformulation	1.4	0.0	89	0
	Wood furniture surface coating	Reformulation	18.9	0.0	27,213	0
	Adhesives - industrial	RACT	543.8	0.0	1,359,416	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	203.0	0.0	3,050,535	0
	Miscellaneous surface coating	MACT level of control	35.0	0.0	87,480	0
	Aerosols	SCAQMD Standards - Reformulati	439.6	0.0	2,747,430	0
	marine surface coating	Add-on control levels	252.0	0.0	3,647,850	0
	SOCMI batch reactor processes	New CTG	1,029.8	0.0	4,174,398	0
	Cutback Asphalt	Switch to emulsified asphalts	1,144.9	0.0	0	0
	SOCMI fugitives	RACT	649.2	0.0	88,456	0
	Pharmaceutical manufacture	RACT	5.7	0.0	1,878	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	270.1	0.0	107,119	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	624.3	0.0	15,609	0
	Web Offset Lithography	New CTG (carbon adsorber)	117.3	0.0	-14,663	0
	Pesticide Application	Reformulation - FIP rule	15.0	0.0	139,202	0
	Recreational vehicles	CARB standards	683.7	0.0	362,286	0
	Motor Vehicles	Federal Reform	7,862.9	1,062.1	17,915,062	0
	Motor Vehicles	Enhanced I/M	6,495.6	4,588.4	1,943,435	3,886,871
	Motor Vehicles	California LEV	2,447.5	3,979.6	3,144,649	3,144,649
		Total	26,781.9	9,862.6	50,467,426	7,031,520
New York, NY	Open Burning	Episodic Ban	309.8	58.7	0	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
	Point Source Ind. Surface Coating	Add-on Control Levels	20.1	0.0	369,380	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	23.7	0.0	47,450	0
	Metal product surface coating	VOC content limits & improved	22.3	0.0	1,182	0
	Wood product surface coating	Reformulation	1.2	0.0	59	0
	Wood furniture surface coating	Reformulation	41.0	0.0	41,407	0
	Paper surface coating	Add-on control levels	1.7	0.0	109,560	0
	Miscellaneous surface coating	Add-on control levels	14.0	0.0	519,847	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	73.3	0.0	1,102,707	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	77.3	0.0	482,250	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.8	0.0	10,930	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	134.8	0.0	3,374	0
	Pesticide Application	Reformulation - FIP rule	13.2	0.0	122,147	0
	Recreational vehicles	CARB standards	33.8	0.0	17,965	0
	Motor Vehicles	California Reform	1,042.5	587.8	3,814,299	4,873,195
	Motor Vehicles	Enhanced I/M	1,700.1	1,441.0	564,759	1,129,519
	Motor Vehicles	California LEV	573.7	1,285.2	914,210	914,210
		Total	4,083.3	3,372.7	8,121,526	6,916,924
Norfolk, VA	Utility Boiler - PC/Wall	SCR	0.0	1,607.9	0	7,019,681
	Utility Boiler - PC/Tangential	SCR	0.0	7,314.9	0	32,483,283
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	1,599.7	0	12,055,511
	Industrial Boiler - PC	SCR	0.0	1,012.2	0	8,058,459
	Industrial Boiler - Stoker	SCR	0.0	444.3	0	2,430,986
	Industrial Boiler - Residual Oil	SCR	0.0	790.4	0	4,044,791
	Industrial Boiler - Distillate Oil	SCR	0.0	134.6	0	1,181,221
	Industrial Boiler - Natural Gas	SCR	0.0	52.7	0	427,031
	IC Engines - Oil	SCR	0.0	37.0	0	393,293
	Gas Turbines - Natural Gas	SCR + STEAM INJECTION	0.0	4.0	0	756,335
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	6.0	0	1,421,641
	Process Heaters - Natural Gas	LNB + SCR	0.0	40.9	0	741,368
	Process Heaters - Distillate Oil	LNB + SCR	0.0	8.2	0	291,284
	Area Source Industrial Coal Comb	RACT to small sources	0.0	196.7	0	785,155
	Area Source Industrial Oil Comb	RACT to small sources	0.0	10.2	0	21,387
	Area Source Industrial NG Comb	RACT to small sources	0.0	157.4	0	263,335
	Residential NG Consumption	LNB Space heaters	0.0	312.0	0	384,394
	Open Burning	Episodic Ban	1,227.3	232.1	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	120.0	0	977,564
	Commercial Marine Vessels	Emission Fees	0.0	1,073.4	0	10,732,157
	Glass Manufacturing - Container	Oxy-Firing	0.0	773.5	0	4,841,947
	Iron & Steel Mills - Reheating	LNB + FGR	0.0	9.7	0	4,973
	Municipal Waste Combustors	SNCR	0.0	39.3	0	123,048
	Motor Vehicles	California Reform	1,345.3	2,142.0	5,469,157	30,333,761

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Motor Vehicles	Enhanced I/M	11,553.4	8,366.2	3,582,246	7,164,492
	Motor Vehicles	California LEV	4,367.3	7,261.6	5,796,411	5,796,411
	Motor Vehicles	Reform Diesel	0.0	364.6	0	5,249,072
		Total	18,493.3	34,111.5	14,847,814	137,982,580
Owensboro, KY	Utility Boiler - PC/Wall	SCR	0.0	4,635.5	0	21,299,059
	Utility Boiler - PC/Tangential	SCR	0.0	1,944.4	0	7,109,311
	Utility Boiler - Cyclone	SCR	0.0	849.3	0	17,090,889
	Industrial Boiler - Stoker	SCR	0.0	98.9	0	1,015,716
	Industrial Boiler - Residual Oil	SCR	0.0	2.6	0	18,936
	Industrial Boiler - Natural Gas	SCR	0.0	30.5	0	244,273
	Area Source Industrial Coal Comb	RACT to small sources	0.0	94.6	0	354,725
	Area Source Industrial Oil Comb	RACT to small sources	0.0	8.8	0	18,458
	Area Source Industrial NG Comb	RACT to small sources	0.0	172.4	0	272,704
	Open Burning	Episodic Ban	168.3	31.9	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	6.4	0	52,795
	Commercial Marine Vessels	Emission Fees	0.0	307.2	0	3,072,058
	Motor Vehicles	California Reform	613.7	219.5	2,568,215	818,529
	Motor Vehicles	Enhanced I/M	740.2	470.9	191,738	383,477
	Motor Vehicles	California LEV	226.7	400.1	310,311	310,311
	Motor Vehicles	Reform Diesel	0.0	24.7	0	383,255
		Total	1,748.9	9,297.7	3,070,263	52,444,495
Philadelphia, PA	Open Burning	Episodic Ban	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Aircraft surface coating	Add-on control levels	0.0	0.0	0	0
	marine surface coating	Add-on control levels	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Motor Vehicles	California Reform	0.0	0.0	0	0
	Motor Vehicles	California LEV	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Phoenix, AZ	Adhesives - industrial	RACT	39.2	0.0	98,028	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
	Aerosols	CARB Tier 2 Standards - Reform	402.0	0.0	1,004,856	0
	Automobile refinishing	CARB BARCT limits	182.6	0.0	671,796	0
	Bulk Terminals	RACT	115.1	0.0	191,712	0
	Cutback Asphalt	Switch to emulsified asphalts	109.7	0.0	0	0
	Metal product surface coating	VOC content limits & improved	521.6	0.0	12,986	0
	Miscellaneous surface coating	MACT level of control	417.7	0.0	1,044,188	0
	Motor Vehicles	Enhanced I/M	21,094.9	12,639.6	1,199,840	2,399,679
	Motor Vehicles	Federal Reform	36,455.7	3,002.3	47,793,100	0
	Nonroad gasoline	Reformulated gasoline	306.9	0.0	1,534,500	0
	Open Burning	Episodic Ban	1,589.9	303.4	0	0
	Recreational vehicles	CARB standards	318.6	0.0	168,875	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,131.7	0.0	212,983	0
	Web Offset Lithography	New CTG (carbon adsorber)	6.4	0.0	-795	0
	Wood furniture surface coating	Reformulation	891.0	0.0	334,128	0
	Wood product surface coating	Reformulation	23.1	0.0	576	0
		Total	63,606.1	15,945.3	54,266,773	2,399,679
Pittsburgh, PA	Open Burning	Episodic Ban	2,807.4	532.4	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	457.3	0.0	8,415,148	0
	Point Source Metal Surface Coating	FIP VOC Limits	94.2	0.0	0	0
	Point Sources	RE Improvements	277.8	0.0	555,530	0
	Metal product surface coating	VOC content limits & improved	279.6	0.0	6,988	0
	Wood product surface coating	Reformulation	6.4	0.0	160	0
	Wood furniture surface coating	Reformulation	170.8	0.0	175,194	0
	Adhesives - industrial	RACT	6.6	0.0	16,405	0
	Paper surface coating	Add-on control levels	9.5	0.0	626,283	0
	Miscellaneous surface coating	Add-on control levels	84.3	0.0	4,084,321	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	601.2	0.0	9,043,663	0
	Aerosols	SCAQMD Standards - Reformulati	756.7	0.0	4,727,880	0
	marine surface coating	Add-on control levels	27.5	0.0	397,368	0
	Cutback Asphalt	Switch to emulsified asphalts	6.9	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,083.1	0.0	38,641	0
	Pesticide Application	Reformulation - FIP rule	41.6	0.0	387,142	0
	Recreational vehicles	CARB standards	276.2	0.0	146,249	0
	Motor Vehicles	California Reform	1,752.0	2,747.3	2,103,421	39,884,440
	Motor Vehicles	Enhanced I/M	3,010.5	2,411.1	934,087	1,868,173
	Motor Vehicles	California LEV	5,656.3	9,697.4	7,585,834	7,585,834
		Total	17,405.9	15,388.2	39,244,314	49,338,447
Portland, ME	Utility Boiler - Oil-Gas/Wall	SCR	0.0	2,505.4	0	15,856,806
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	340.5	0	3,213,853
	Industrial Boiler - PC	SCR	0.0	185.3	0	3,961,642
	Industrial Boiler - Residual Oil	SCR	0.0	140.7	0	967,230
	Industrial Boiler - Distillate Oil	LNB + FGR	0.0	0.7	0	6,724

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Area Source Industrial Coal Comb	RACT to small sources	0.0	0.1	0	235
	Area Source Industrial Oil Comb	RACT to small sources	0.0	2.1	0	4,290
	Open Burning	Episodic Ban	496.9	94.4	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	2.4	0	19,701
	Commercial Marine Vessels	Emission Fees	0.0	90.8	0	907,683
	Motor Vehicles	California Reform	152.1	361.1	70,000	5,228,271
	Motor Vehicles	California LEV	672.9	1,278.1	990,028	990,028
	Motor Vehicles	Reform Diesel	0.0	85.0	0	1,256,653
		Total	1,321.9	5,086.6	1,060,028	32,413,116
Portland, OR	Bulk Terminals	RACT	364.1	0.0	606,885	0
	Cutback Asphalt	Switch to emulsified asphalts	320.2	0.0	0	0
	Metal product surface coating	VOC content limits & improved	406.7	0.0	10,136	0
	Motor Vehicles	Enhanced I/M	11,068.2	10,483.5	1,747,796	3,495,591
	Open Burning	Episodic Ban	2,265.5	429.5	0	0
	Pharmaceutical manufacture	RACT	4.2	0.0	1,408	0
	Point Source Metal Surface Coating	FIP VOC Limits	139.8	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	217.2	0.0	5,429	0
	Point Sources	RE Improvements	19,187.0	0.0	38,373,910	0
	Recreational vehicles	CARB standards	403.8	0.0	214,057	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,432.7	0.0	562,989	0
	SOCMI fugitives	RACT	12.7	0.0	1,729	0
	Web Offset Lithography	New CTG (carbon adsorber)	259.3	0.0	-32,399	0
	Wood furniture surface coating	Reformulation	487.7	0.0	182,937	0
	Wood product surface coating	Reformulation	43.4	0.0	1,779	0
		Total	36,612.5	10,913.0	41,676,656	3,495,591
Providence, RI	Open Burning	Episodic Ban	560.1	106.4	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	177.8	0.0	3,270,692	0
	Point Source Metal Surface Coating	FIP VOC Limits	129.6	0.0	0	0
	Point Sources	RE Improvements	2,381.3	0.0	4,762,520	0
	Metal product surface coating	VOC content limits & improved	481.8	0.0	11,958	0
	Wood product surface coating	Reformulation	5.6	0.0	141	0
	Wood furniture surface coating	Reformulation	403.0	0.0	151,099	0
	Paper surface coating	Add-on control levels	3.3	0.0	220,089	0
	Miscellaneous surface coating	Add-on control levels	195.0	0.0	3,156,486	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	434.2	0.0	6,533,259	0
	Miscellaneous surface coating	MACT level of control	148.9	0.0	372,146	0
	Aerosols	SCAQMD Standards - Reformulati	296.8	0.0	1,854,330	0
	marine surface coating	Add-on control levels	134.5	0.0	1,946,944	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	356.5	0.0	8,909	0
	Pesticide Application	Reformulation - FIP rule	2.8	0.0	26,709	0
	Recreational vehicles	CARB standards	789.7	0.0	418,473	0
	Motor Vehicles	California Reform	590.1	1,002.0	737,000	15,574,996

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Motor Vehicles	California LEV	2,302.1	3,756.5	2,980,279	2,980,279
		Total	9,393.1	4,864.9	26,451,034	18,555,275
Raleigh, NC	Utility Boiler - PC/Wall	SCR	0.0	15,829.6	0	54,107,501
	Utility Boiler - PC/Tangential	SCR	0.0	8,264.7	0	31,912,250
	Industrial Boiler - Stoker	SCR	0.0	605.6	0	2,825,174
	Industrial Boiler - Residual Oil	SCR	0.0	252.1	0	1,078,929
	Industrial Boiler - Natural Gas	SCR	0.0	8.8	0	74,162
	Area Source Industrial Coal Comb	RACT to small sources	0.0	74.8	0	298,384
	Area Source Industrial Oil Comb	RACT to small sources	0.0	5.3	0	11,550
	Area Source Industrial NG Comb	RACT to small sources	0.0	74.9	0	125,595
	Open Burning	Episodic Ban	1,431.1	271.5	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	102.6	0	837,631
	Motor Vehicles	California Reform	6,674.8	2,598.9	21,432,082	20,099,873
	Motor Vehicles	Enhanced I/M	6,757.8	5,523.1	1,098,794	2,197,589
	Motor Vehicles	California LEV	2,734.3	4,864.7	3,819,443	3,819,443
	Motor Vehicles	Reform Diesel	0.0	297.5	0	4,361,319
		Total	17,598.0	38,774.1	26,350,319	121,749,400
Redding, CA	Adhesives - industrial	RACT	97.0	0.0	242,361	0
	Aerosols	CARB Tier 2 Standards - Reform	26.1	0.0	65,190	0
	Aerosols	SCAQMD Standards - Reformulati	26.1	0.0	260,760	0
	Automobile refinishing	CARB BARCT limits	12.7	0.0	46,813	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	48.6	0.0	875,746	0
	Bulk Terminals	RACT	303.5	0.0	505,794	0
	Cutback Asphalt	Switch to emulsified asphalts	180.7	0.0	0	0
	marine surface coating	Add-on control levels	6.4	0.0	93,094	0
	Metal product surface coating	VOC content limits & improved	18.8	0.0	468	0
	Miscellaneous surface coating	Add-on control levels	8.6	0.0	133,220	0
	Miscellaneous surface coating	MACT level of control	3.7	0.0	9,223	0
	Motor Vehicles	Enhanced I/M	2,316.3	3,420.1	841,481	1,682,962
	Nonroad gasoline	Reformulated gasoline	13.7	0.0	68,500	0
	Open Burning	Episodic Ban	15.6	3.0	0	0
	Paper surface coating	Add-on control levels	64.3	0.0	774,483	0
	Pesticide Application	Reformulation - FIP rule	24.2	0.0	225,693	0
	Recreational vehicles	CARB standards	12.8	0.0	6,824	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	731.0	0.0	547,670	0
	Web Offset Lithography	New CTG (carbon adsorber)	14.3	0.0	-1,791	0
	Wood furniture surface coating	Reformulation	7.4	0.0	2,761	0
	Wood product surface coating	Reformulation	8.3	0.0	208	0
		Total	3,940.1	3,423.1	4,698,498	1,682,962
Redding, PA	Open Burning	Episodic Ban	432.9	82.1	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	442.7	0.0	8,146,508	0
	Point Source Metal Surface Coating	FIP VOC Limits	130.7	0.0	0	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Point Source Wood Product Coating	FIP VOC Limits	54.8	0.0	1,369	0
	Point Sources	RE Improvements	46.7	0.0	93,440	0
	Wood product surface coating	Reformulation	9.2	0.0	230	0
	Wood furniture surface coating	Reformulation	59.3	0.0	60,839	0
	Miscellaneous surface coating	Add-on control levels	238.5	0.0	12,666,820	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	78.1	0.0	1,174,411	0
	Aerosols	SCAQMD Standards - Reformulati	93.4	0.0	584,070	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	110.5	0.0	2,763	0
	Pesticide Application	Reformulation - FIP rule	28.4	0.0	263,729	0
	Recreational vehicles	CARB standards	39.9	0.0	21,112	0
	Motor Vehicles	California Reform	185.2	336.3	129,000	4,900,950
	Motor Vehicles	California LEV	648.1	1,207.3	927,301	927,301
		Total	2,598.4	1,625.7	24,071,592	5,828,251
Reno, NV	Aerosols	CARB Tier 2 Standards - Reform	44.1	0.0	110,244	0
	Automobile refinishing	CARB BARCT limits	30.8	0.0	113,240	0
	Metal product surface coating	VOC content limits & improved	37.5	0.0	934	0
	Miscellaneous surface coating	MACT level of control	30.7	0.0	76,867	0
	Motor Vehicles	Enhanced I/M	1,537.1	1,483.5	94,145	188,291
	Motor Vehicles	Federal Reform	1,919.7	357.6	5,606,016	0
	Nonroad gasoline	Reformulated gasoline	39.8	0.0	199,000	0
	Open Burning	Episodic Ban	82.3	15.6	0	0
	Recreational vehicles	CARB standards	118.5	0.0	62,805	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	153.1	0.0	3,845	0
	Web Offset Lithography	New CTG (carbon adsorber)	97.0	0.0	-12,130	0
	Wood furniture surface coating	Reformulation	68.8	0.0	25,794	0
	Wood product surface coating	Reformulation	2.0	0.0	50	0
		Total	4,161.4	1,856.7	6,280,810	188,291
Richmond, VA	Utility Boiler - PC/Tangential	SCR	0.0	11,955.4	0	43,177,923
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	538.5	0	4,463,115
	Industrial Boiler - PC	SCR	0.0	1,587.5	0	21,934,490
	Industrial Boiler - Stoker	SCR	0.0	440.9	0	2,357,476
	Industrial Boiler - Residual Oil	SCR	0.0	513.3	0	1,780,719
	Industrial Boiler - Distillate Oil	SCR	0.0	11.1	0	118,589
	Industrial Boiler - Natural Gas	SCR	0.0	1,061.8	0	3,992,143
	Adipic Acid Manufacturing Plant	Thermal Reduction	0.0	12.4	0	6,762
	Area Source Industrial Coal Comb	RACT to small sources	0.0	115.2	0	459,773
	Area Source Industrial Oil Comb	RACT to small sources	0.0	6.8	0	14,682
	Area Source Industrial NG Comb	RACT to small sources	0.0	62.5	0	105,343
	Residential NG Consumption	LNB Space heaters	0.0	177.8	0	220,153
	Open Burning	Episodic Ban	1,249.5	236.8	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	70.8	0	578,031
	Commercial Marine Vessels	Emission Fees	0.0	47.9	0	477,250

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Motor Vehicles	California Reform	3,349.5	1,926.2	10,913,162	20,164,186
	Motor Vehicles	Enhanced I/M	6,470.9	5,505.6	844,761	1,689,523
	Motor Vehicles	California LEV	2,709.4	4,900.3	3,839,138	3,839,138
	Motor Vehicles	Reform Diesel	0.0	276.1	0	3,995,044
		Total	13,779.3	29,446.9	15,597,061	109,374,339
Rochester, NY	Open Burning	Episodic Ban	629.4	119.6	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	763.6	0.0	14,049,872	0
	Point Source Metal Surface Coating	FIP VOC Limits	75.6	0.0	0	0
	Point Sources	RE Improvements	25,595.7	0.0	51,191,250	0
	Metal product surface coating	VOC content limits & improved	240.3	0.0	25,473	0
	Wood product surface coating	Reformulation	2.0	0.0	124	0
	Wood furniture surface coating	Reformulation	114.8	0.0	112,992	0
	Paper surface coating	Add-on control levels	14.4	0.0	957,544	0
	Miscellaneous surface coating	Add-on control levels	210.4	0.0	10,611,787	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	256.1	0.0	3,851,060	0
	Aerosols	SCAQMD Standards - Reformulati	279.4	0.0	1,745,730	0
	Aircraft surface coating	Add-on control levels	1.5	0.0	43,595	0
	marine surface coating	Add-on control levels	9.6	0.0	138,035	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	458.1	0.0	11,505	0
	Pesticide Application	Reformulation - FIP rule	164.7	0.0	1,532,139	0
	Recreational vehicles	CARB standards	121.5	0.0	64,362	0
	Motor Vehicles	California Reform	3,072.7	2,166.9	19,793,433	18,561,178
	Motor Vehicles	Enhanced I/M	765.1	658.5	259,659	519,317
	Motor Vehicles	California LEV	2,674.0	4,960.3	3,522,006	3,522,006
		Total	35,448.9	7,905.3	107,910,565	22,602,501
Sacramento, CA	Adhesives - industrial	RACT	34.5	0.0	86,360	0
	Aerosols	CARB Tier 2 Standards - Reform	201.3	0.0	503,034	0
	Aerosols	SCAQMD Standards - Reformulati	201.2	0.0	2,012,136	0
	Automobile refinishing	CARB BARCT limits	127.1	0.0	467,563	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	485.3	0.0	8,746,744	0
	Bulk Terminals	RACT	12.8	0.0	21,347	0
	Cutback Asphalt	Switch to emulsified asphalts	72.2	0.0	0	0
	marine surface coating	Add-on control levels	4.2	0.0	60,687	0
	Metal product surface coating	VOC content limits & improved	236.7	0.0	5,867	0
	Miscellaneous surface coating	Add-on control levels	119.5	0.0	1,938,485	0
	Miscellaneous surface coating	MACT level of control	105.2	0.0	262,951	0
	Motor Vehicles	Enhanced I/M	828.8	1,377.3	326,808	653,615
	Nonroad gasoline	Reformulated gasoline	106.5	0.0	532,500	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Open Burning	Episodic Ban	444.0	84.0	0	0
	Paper surface coating	Add-on control levels	3.1	0.0	206,239	0
	Pesticide Application	Reformulation - FIP rule	114.2	0.0	1,062,488	0
	Point Source Ind. Surface Coating	Add-on Control Levels	361.7	0.0	6,655,556	0
	Point Source Metal Surface Coating	FIP VOC Limits	313.9	0.0	0	0
	Point Sources	RE Improvements	40.5	0.0	81,030	0
	Recreational vehicles	CARB standards	102.4	0.0	54,329	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	799.0	0.0	130,285	0
	Web Offset Lithography	New CTG (carbon adsorber)	6.6	0.0	-825	0
	Wood furniture surface coating	Reformulation	252.5	0.0	94,698	0
	Wood product surface coating	Reformulation	16.0	0.0	399	0
		Total	4,989.2	1,461.3	23,248,681	653,615
St. Louis, MO	Open Burning	Episodic Ban	1,840.5	348.9	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	7,257.0	0.0	133,527,512	0
	Point Source Metal Surface Coating	FIP VOC Limits	874.2	0.0	0	0
	Point Sources	RE Improvements	3,298.8	0.0	6,597,740	0
	Bulk Terminals	RACT	80.7	0.0	134,334	0
	Metal product surface coating	VOC content limits & improved	848.6	0.0	36,276	0
	Wood product surface coating	Reformulation	7.4	0.0	181	0
	Wood furniture surface coating	Reformulation	575.3	0.0	572,466	0
	Adhesives - industrial	RACT	75.5	0.0	188,420	0
	Paper surface coating	Add-on control levels	40.0	0.0	2,956,315	0
	Miscellaneous surface coating	Add-on control levels	393.3	0.0	18,678,835	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	914.9	0.0	13,762,359	0
	Miscellaneous surface coating	MACT level of control	180.9	0.0	452,528	0
	Aerosols	SCAQMD Standards - Reformulati	770.9	0.0	4,818,120	0
	Aircraft surface coating	Add-on control levels	120.4	0.0	3,790,114	0
	marine surface coating	Add-on control levels	17.6	0.0	255,434	0
	Cutback Asphalt	Switch to emulsified asphalts	189.5	0.0	0	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	14.6	0.0	5,812	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	1,430.7	0.0	160,749	0
	Web Offset Lithography	New CTG (carbon adsorber)	13.2	0.0	-1,647	0
	Pesticide Application	Reformulation - FIP rule	376.4	0.0	3,501,244	0
	Recreational vehicles	CARB standards	273.5	0.0	144,727	0
	Motor Vehicles	California Reform	15,021.2	6,273.9	52,150,497	49,212,883
	Motor Vehicles	Enhanced I/M	16,476.5	13,312.3	1,339,931	2,679,863
	Motor Vehicles	California LEV	6,609.0	11,949.2	9,385,105	9,385,105
		Total	57,700.6	31,884.3	252,457,052	61,277,850

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
San Diego, CA	Aerosols	CARB Tier 2 Standards - Reform	0.0	0.0	0	0
	Aerosols	SCAQMD Standards - Reformulati	0.0	0.0	0	0
	Automobile refinishing	CARB BARCT limits	0.0	0.0	0	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	0.0	0.0	0	0
	Metal product surface coating	VOC content limits & improved	0.0	0.0	0	0
	Miscellaneous surface coating	Add-on control levels	0.0	0.0	0	0
	Miscellaneous surface coating	MACT level of control	0.0	0.0	0	0
	Nonroad gasoline	Reformulated gasoline	0.0	0.0	0	0
	Open Burning	Episodic Ban	0.0	0.0	0	0
	Paper surface coating	Add-on control levels	0.0	0.0	0	0
	Pesticide Application	Reformulation - FIP rule	0.0	0.0	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	0.0	0.0	0	0
	Point Sources	RE Improvements	0.0	0.0	0	0
	Recreational vehicles	CARB standards	0.0	0.0	0	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	0.0	0.0	0	0
	Wood furniture surface coating	Reformulation	0.0	0.0	0	0
	Wood product surface coating	Reformulation	0.0	0.0	0	0
		Total	0.0	0.0	0	0
Santa Barbara, CA	Aerosols	CARB Tier 2 Standards - Reform	50.1	0.0	125,256	0
	Aerosols	SCAQMD Standards - Reformulati	50.1	0.0	501,024	0
	Aircraft surface coating	Add-on control levels	10.5	0.0	330,223	0
	Automobile refinishing	CARB BARCT limits	25.1	0.0	92,413	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	95.9	0.0	1,728,785	0
	Metal product surface coating	VOC content limits & improved	44.0	0.0	1,098	0
	Miscellaneous surface coating	Add-on control levels	18.2	0.0	303,110	0
	Miscellaneous surface coating	MACT level of control	45.7	0.0	114,149	0
	Motor Vehicles	Enhanced I/M	1,827.6	2,680.2	106,112	212,224
	Nonroad gasoline	Reformulated gasoline	26.0	0.0	130,000	0
	Open Burning	Episodic Ban	134.4	25.5	0	0
	Paper surface coating	Add-on control levels	1.3	0.0	84,224	0
	Pesticide Application	Reformulation - FIP rule	34.8	0.0	323,156	0
	Point Sources	RE Improvements	91.6	0.0	183,230	0
	Recreational vehicles	CARB standards	5.8	0.0	3,072	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	196.0	0.0	4,901	0
	Wood furniture surface coating	Reformulation	52.3	0.0	19,616	0
	Wood product surface coating	Reformulation	1.6	0.0	40	0
		Total	2,711.0	2,705.7	4,050,409	212,224
Seattle, WA	Adhesives - industrial	RACT	105.8	0.0	264,172	0
	Aerosols	CARB Tier 2 Standards - Reform	467.2	0.0	1,167,756	0
	Aerosols	SCAQMD Standards - Reformulati	467.0	0.0	4,671,024	0
	Automobile refinishing	CARB BARCT limits	250.9	0.0	922,119	0
	Bulk Terminals	RACT	248.4	0.0	413,881	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Cutback Asphalt	Switch to emulsified asphalts	454.5	0.0	0	0
	Metal product surface coating	VOC content limits & improved	578.7	0.0	14,445	0
	Miscellaneous surface coating	MACT level of control	240.4	0.0	601,215	0
	Motor Vehicles	California LEV	8,992.7	15,879.0	12,434,797	12,434,797
	Motor Vehicles	California Reform	1,615.1	4,241.6	0	65,175,421
	Motor Vehicles	Enhanced I/M	4,292.7	3,491.0	1,372,151	2,744,303
	Motor Vehicles	Federal Reform	11,865.0	3,331.6	67,981,645	0
	Nonroad gasoline	Reformulated gasoline	292.5	0.0	1,462,500	0
	Open Burning	Episodic Ban	1,232.7	233.9	0	0
	Pesticide Application	Reformulation - FIP rule	71.3	0.0	662,233	0
	Point Source Metal Surface Coating	FIP VOC Limits	8.8	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	93.1	0.0	2,327	0
	Recreational vehicles	CARB standards	628.9	0.0	333,244	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	2,104.6	0.0	699,089	0
	Web Offset Lithography	New CTG (carbon adsorber)	532.5	0.0	-66,548	0
	Wood furniture surface coating	Reformulation	989.4	0.0	371,013	0
	Wood product surface coating	Reformulation	22.6	0.0	1,182	0
		Total	35,554.8	27,177.1	93,308,245	80,354,520
Sherman, TX	Open Burning	Episodic Ban	145.0	27.5	0	0
	Bulk Terminals	RACT	214.3	0.0	356,978	0
	Metal product surface coating	VOC content limits & improved	34.5	0.0	859	0
	Wood furniture surface coating	Reformulation	26.7	0.0	9,996	0
	Cutback Asphalt	Switch to emulsified asphalts	122.5	0.0	0	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	5.5	0.0	2,184	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	209.1	0.0	156,635	0
	Web Offset Lithography	New CTG (carbon adsorber)	12.4	0.0	-1,559	0
	Recreational vehicles	CARB standards	22.4	0.0	11,814	0
	Motor Vehicles	Enhanced I/M	1,051.8	856.8	339,174	678,347
		Total	1,844.2	884.3	876,081	678,347
Shreveport, LA	Open Burning	Episodic Ban	504.4	95.6	0	0
	Point Source Metal Surface Coating	FIP VOC Limits	11.3	0.0	0	0
	Point Sources	RE Improvements	83.6	0.0	167,170	0
	Metal product surface coating	VOC content limits & improved	78.1	0.0	3,590	0
	Wood product surface coating	Reformulation	2.4	0.0	157	0
	Wood furniture surface coating	Reformulation	3.8	0.0	5,420	0
	Adhesives - industrial	RACT	65.3	0.0	163,220	0
	Automobile refinishing	CARB BARCT limits	21.3	0.0	77,831	0
	Miscellaneous surface coating	MACT level of control	29.1	0.0	72,735	0
	Aerosols	CARB Tier 2 Standards - Reform	71.5	0.0	178,740	0
	Cutback Asphalt	Switch to emulsified asphalts	372.2	0.0	0	0
	Pharmaceutical manufacture	RACT	40.4	0.0	13,542	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Oil and natural gas production fiel	RACT (equipment/maintenance)	355.7	0.0	141,071	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	218.6	0.0	5,470	0
	Web Offset Lithography	New CTG (carbon adsorber)	43.6	0.0	-5,439	0
	Recreational vehicles	CARB standards	218.5	0.0	115,850	0
	Motor Vehicles	Federal Reform	3,423.2	502.6	8,125,082	0
	Motor Vehicles	Enhanced I/M	2,844.1	2,159.7	886,918	1,773,836
		Total	8,387.1	2,757.9	9,951,357	1,773,836
Springfield, MA	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	256.4	0	6,961,478
	Industrial Boiler - PC	SCR	0.0	44.3	0	948,195
	Industrial Boiler - Stoker	SCR	0.0	108.2	0	1,127,084
	Industrial Boiler - Residual Oil	SCR	0.0	141.9	0	976,271
	Industrial Boiler - Natural Gas	SCR	0.0	159.9	0	1,342,660
	IC Engines - Natural Gas	NSCR	0.0	58.5	0	179,810
	Gas Turbines - Natural Gas	SCR + STEAM INJECTION	0.0	106.6	0	511,328
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	146.7	0	731,902
	Residential NG Consumption	LNB Space heaters	0.0	531.5	0	653,642
	Open Burning	Episodic Ban	2,129.9	404.0	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	33.8	0	275,292
	Commercial Marine Vessels	Emission Fees	0.0	252.3	0	2,523,158
	Motor Vehicles	California Reform	398.0	672.7	467,000	10,679,254
	Motor Vehicles	California LEV	1,714.3	2,857.2	2,038,322	2,038,322
	Motor Vehicles	Reform Diesel	0.0	134.5	0	1,911,328
		Total	4,242.2	5,908.5	2,505,322	30,859,724
State College, PA	Open Burning	Episodic Ban	503.9	95.5	0	0
	Point Sources	RE Improvements	15.3	0.0	30,660	0
	Metal product surface coating	VOC content limits & improved	37.4	0.0	937	0
	Wood furniture surface coating	Reformulation	28.8	0.0	29,558	0
	Automobile refinishing	CARB BARCT limits	4.6	0.0	16,614	0
	Aerosols	CARB Tier 2 Standards - Reform	34.2	0.0	85,344	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	98.7	0.0	2,467	0
	Recreational vehicles	CARB standards	27.7	0.0	14,690	0
	Motor Vehicles	Federal Reform	857.8	237.2	4,280,050	0
	Motor Vehicles	Enhanced I/M	750.9	651.4	253,802	507,603
		Total	2,359.3	984.1	4,714,122	507,603
Stockton, CA	Aerosols	CARB Tier 2 Standards - Reform	63.9	0.0	159,828	0
	Aerosols	SCAQMD Standards - Reformulati	63.9	0.0	639,312	0
	Automobile refinishing	CARB BARCT limits	30.9	0.0	113,829	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	118.2	0.0	2,129,416	0
	marine surface coating	Add-on control levels	2.6	0.0	37,680	0
	Metal product surface coating	VOC content limits & improved	315.6	0.0	7,806	0
	Miscellaneous surface coating	Add-on control levels	86.9	0.0	1,429,779	0
	Miscellaneous surface coating	MACT level of control	38.0	0.0	94,975	0
	Nonroad gasoline	Reformulated gasoline	32.9	0.0	164,500	0
	Open Burning	Episodic Ban	146.1	27.8	0	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Paper surface coating	Add-on control levels	5.3	0.0	358,421	0
	Pesticide Application	Reformulation - FIP rule	162.5	0.0	1,510,952	0
	Point Source Wood Product Coating	FIP VOC Limits	138.0	0.0	3,449	0
	Recreational vehicles	CARB standards	31.5	0.0	16,720	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	184.4	0.0	4,610	0
	Wood furniture surface coating	Reformulation	214.0	0.0	80,240	0
		Total	1,634.7	27.8	6,751,517	0
Tulsa, OK	Open Burning	Episodic Ban	537.5	101.6	0	0
	Point Sources	RE Improvements	1,413.6	0.0	2,827,290	0
	Bulk Terminals	RACT	198.9	0.0	331,281	0
	Metal product surface coating	VOC content limits & improved	220.5	0.0	5,451	0
	Wood product surface coating	Reformulation	3.9	0.0	97	0
	Wood furniture surface coating	Reformulation	278.4	0.0	104,400	0
	Adhesives - industrial	RACT	785.4	0.0	1,963,118	0
	Automobile refinishing	CARB BARCT limits	51.7	0.0	190,487	0
	Miscellaneous surface coating	MACT level of control	240.3	0.0	600,760	0
	Aerosols	CARB Tier 2 Standards - Reform	137.3	0.0	343,158	0
	SOCMI batch reactor processes	New CTG	25.8	0.0	104,520	0
	Cutback Asphalt	Switch to emulsified asphalts	771.7	0.0	0	0
	SOCMI fugitives	RACT	11.9	0.0	1,625	0
	Petroleum refinery fugitives	RACT	104.1	0.0	-46,863	0
	Oil and natural gas production fiel	RACT (equipment/maintenance)	937.6	0.0	371,851	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	873.8	0.0	445,291	0
	Web Offset Lithography	New CTG (carbon adsorber)	154.5	0.0	-19,309	0
	Recreational vehicles	CARB standards	114.7	0.0	60,729	0
	Nonroad gasoline	Reformulated gasoline	70.0	0.0	350,000	0
	Motor Vehicles	Enhanced I/M	6,821.7	5,222.1	571,779	1,143,558
		Total	13,753.3	5,323.7	8,205,665	1,143,558
Visalia, CA	Aerosols	CARB Tier 2 Standards - Reform	42.6	0.0	106,380	0
	Aerosols	SCAQMD Standards - Reformulati	42.6	0.0	425,520	0
	Automobile refinishing	CARB BARCT limits	11.2	0.0	41,327	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	42.9	0.0	773,106	0
	Metal product surface coating	VOC content limits & improved	49.9	0.0	1,238	0
	Miscellaneous surface coating	Add-on control levels	22.0	0.0	333,737	0
	Miscellaneous surface coating	MACT level of control	19.7	0.0	49,270	0
	Nonroad gasoline	Reformulated gasoline	23.1	0.0	115,500	0
	Open Burning	Episodic Ban	93.7	17.7	0	0
	Pesticide Application	Reformulation - FIP rule	250.4	0.0	2,329,073	0
	Recreational vehicles	CARB standards	22.4	0.0	11,867	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	110.8	0.0	2,770	0
	Wood furniture surface coating	Reformulation	8.2	0.0	3,088	0
	Wood product surface coating	Reformulation	2.7	0.0	67	0
		Total	742.2	17.7	4,192,943	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	Reductions (tons per year) NOx	Costs (1990$) VOC	Costs (1990$) NOx
Washington, DC	Utility Boiler - PC/Wall	SCR	0.0	28,076.6	0	86,025,342
	Utility Boiler - PC/Tangential	SCR	0.0	25,456.0	0	101,567,747
	Utility Boiler - Oil-Gas/Wall	SCR	0.0	5,738.6	0	52,216,489
	Utility Boiler - Oil-Gas/Tangential	SCR	0.0	3,364.4	0	41,194,478
	Utility Boiler - Cyclone	SCR	0.0	3,413.4	0	37,657,192
	Industrial Boiler - PC	SCR	0.0	3,950.8	0	31,280,313
	Industrial Boiler - Stoker	SCR	0.0	118.1	0	1,230,065
	Industrial Boiler - Residual Oil	SCR	0.0	732.0	0	4,802,598
	Industrial Boiler - Distillate Oil	SCR	0.0	107.4	0	1,126,767
	Industrial Boiler - Natural Gas	SCR	0.0	938.5	0	7,879,698
	IC Engines - Oil	SCR	0.0	362.2	0	1,968,033
	Gas Turbines - Oil	SCR + WATER INJECTION	0.0	49.0	0	2,761,373
	Process Heaters - Natural Gas	LNB + SCR	0.0	6.3	0	183,156
	Area Source Industrial Coal Comb	RACT to small sources	0.0	29.9	0	118,821
	Area Source Industrial Oil Comb	RACT to small sources	0.0	64.9	0	115,430
	Area Source Industrial NG Comb	RACT to small sources	0.0	91.4	0	120,733
	Residential NG Consumption	LNB Space heaters	0.0	2,652.8	0	3,262,702
	Open Burning	Episodic Ban	1,410.2	268.2	0	0
	Nonroad Diesels	CARB Stds for > 175 HP	0.0	504.6	0	4,116,305
	Commercial Marine Vessels	Emission Fees	0.0	642.8	0	6,426,113
	Industrial Boiler - Other	SCR	0.0	15.8	0	169,106
	Glass Manufacturing - Container	Oxy-Firing	0.0	59.9	0	396,919
	Cement Manufacturing - Dry	SCR	0.0	2,187.8	0	11,048,592
	Cement Manufacturing - Wet	SCR	0.0	808.4	0	3,405,438
	Iron & Steel Mills - Reheating	LNB + FGR	0.0	444.8	0	233,562
	Iron & Steel Mills - Annealing	LNB + SCR	0.0	70.3	0	360,338
	Municipal Waste Combustors	SNCR	0.0	140.2	0	467,984
	Point Source Ind. Surface Coating	Add-on Control Levels	353.0	0.0	6,494,372	0
	Point Source Metal Surface Coating	FIP VOC Limits	827.5	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	127.4	0.0	3,185	0
	Point Sources	RE Improvements	5,634.0	0.0	11,268,280	0
	Bulk Terminals	RACT	833.1	0.0	1,388,281	0
	Metal product surface coating	VOC content limits & improved	723.2	0.0	30,335	0
	Wood product surface coating	Reformulation	27.6	0.0	828	0
	Wood furniture surface coating	Reformulation	1,304.8	0.0	534,243	0
	Adhesives - industrial	RACT	183.2	0.0	458,274	0
	Paper surface coating	Add-on control levels	91.5	0.0	3,946,687	0
	Miscellaneous surface coating	Add-on control levels	491.0	0.0	10,149,674	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	2,374.9	0.0	35,730,472	0
	Miscellaneous surface coating	MACT level of control	139.0	0.0	347,320	0
	Aerosols	SCAQMD Standards - Reformulati	1,976.7	0.0	12,350,940	0

Table B-8 (continued)

Nonattainment Area	Source Category	Control Measure	Reductions (tons per year) VOC	NOx	Costs (1990$) VOC	NOx
	Aircraft surface coating	Add-on control levels	21.9	0.0	787,137	0
	marine surface coating	Add-on control levels	106.1	0.0	1,532,530	0
	Cutback Asphalt	Switch to emulsified asphalts	244.6	0.0	0	0
	Synthetic fiber manufacture	RACT (adsorber)	1,408.2	0.0	1,991,973	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	3,815.4	0.0	622,837	0
	Web Offset Lithography	New CTG (carbon adsorber)	38.6	0.0	-4,832	0
	Pesticide Application	Reformulation - FIP rule	356.5	0.0	3,314,467	0
	Recreational vehicles	CARB standards	874.2	0.0	463,181	0
	Motor Vehicles	Federal Reform	4,402.6	902.9	17,493,10 2	0
	Motor Vehicles	Enhanced I/M	4,267.8	4,103.5	1,581,906	3,163,811
	Motor Vehicles	California LEV	16,299.5	30,122.4	23,627,28 5	23,627,285
	Motor Vehicles	Reform Diesel	0.0	1,607.5	0	23,591,507
		Total	48,332.5	117,031. 4	134,112,4 77	450,517,89 7
York, PA	Open Burning	Episodic Ban	482.7	91.6	0	0
	Point Source Ind. Surface Coating	Add-on Control Levels	4.4	0.0	80,592	0
	Point Source Metal Surface Coating	FIP VOC Limits	17.2	0.0	0	0
	Point Source Wood Product Coating	FIP VOC Limits	146.7	0.0	3,668	0
	Metal product surface coating	VOC content limits & improved	88.2	0.0	2,202	0
	Wood furniture surface coating	Reformulation	173.5	0.0	178,051	0
	Paper surface coating	Add-on control levels	19.1	0.0	1,278,337	0
	Miscellaneous surface coating	Add-on control levels	79.9	0.0	3,823,188	0
	Automobile refinishing	FIP Rule (VOC Content & TE)	94.2	0.0	1,417,266	0
	Aerosols	SCAQMD Standards - Reformulati	95.0	0.0	593,850	0
	Service stations - stage I-truck un	Vapor balance & P-V valves	108.5	0.0	2,714	0
	Pesticide Application	Reformulation - FIP rule	31.7	0.0	294,866	0
	Recreational vehicles	CARB standards	40.1	0.0	21,282	0
	Motor Vehicles	California Reform	192.6	421.3	130,500	6,049,430
	Motor Vehicles	California LEV	761.5	1,490.6	1,144,472	1,144,472
		Total	2,335.3	2,003.5	8,970,988	7,193,902

APPENDIX C

CONTROL MEASURE AND SIC CODE SUPPORTING DATA

Table C-1. Summary of Incremental Control Measures and Potentially Affected Source Categories for the Ozone NAAQS Review

Source Category	Control Measure
Stationary Point Sources	
VOC Emissions	
Automobile and Light-Duty Truck Surface Coating (Industrial Surface Coating)	Add-on Control Levels
Plastic Parts Surface Coating (Industrial Surface Coating)	Add-on Control Levels
Flatwood Products Surface Coating (Wood Products Surface Coating)	California (CA) ozone Federal Implementation Plan (FIP) VOC limits
Wood Furniture Surface Coating (Wood Products Surface Coating)	CA FIP VOC limits
General/Unspecified Surface Coating Operations (Industrial Surface Coating)	Add-on Control Levels
General/Unspecified Surface Coating Operations (Wood Products Surface Coating)	CA FIP VOC limits
Metal Product Surface Coating	FIP VOC limits
Rule Effectiveness Improvements	Increase Compliance with Regulations
Incineration/Open Burning	Episodic Ban
NOx Emissions	
Utility Boilers: Oil-Gas Tangentially Fired	Selective Catalytic Reduction (SCR)
Industrial Boilers: Pulverized Coal	SCR
Industrial Boilers: Stoker (Coal)	SCR
Industrial Boilers: Residual Oil	SCR
Industrial Boilers: Distillate Oil	SCR
Industrial Boilers: Natural Gas	SCR
Cement Manufacturing: Dry Kiln	SCR
Glass Manufacturing: Container Glass	Oxy-Firing
Gas Turbines: Natural Gas	SCR + Steam Injection
Gas Turbines: Oil	SCR + Water Injection
Reciprocating Internal Combustion Engines: Natural Gas	Nonselective Catalytic Reduction (NSCR)
Process Heaters: Natural Gas	Low-NOx Burners (LNB) + SCR
Process Heaters: Distillate Oil	LNB + SCR
Municipal Waste Incinerators	Selective Noncatalytic Reduction (SNCR)
Incineration/Open Burning	Episodic Ban
Stationary Area Sources	
VOC Emissions	
Gasoline Service Stations: Underground Storage Tanks and Stage I - Truck Unloading	Install Pressure Vacuum (PV) Valves on Vent Line + Vapor Balance [Clean Air Act (CAA) Base Case Extended to Other Areas]
Bulk Terminals	Reasonably Available Control Technology (RACT): CAA Base Case Extended to Other Areas
Adhesives: Industrial	RACT: CAA Base Case Extended to Other Areas
Aircraft Surface Coating (Industrial)	Add-on Control Levels
Autobody Refinishing	CA Best Available Retrofit Control Technology (BARCT)
Autobody Refinishing	CA FIP Limits
Paper Surface Coating (Industrial)	Add-on Control Levels
Flatwood Product Surface Coating	Reformulation
Wood Furniture Surface Coating	Reformulation

Table C-1 (continued)

Source Category	Control Measure
Stationary Area Sources (cont'd)	
VOC Emissions	
Marine Surface Coating	Add-on Control Levels
Metal Product Surface Coating	VOC Content Limits and Improved Transfer Efficiency
Miscellaneous Surface Coating	Add-on Control Levels
Miscellaneous Surface Coating	Default Maximum Control Technology (MACT) Surface Coating Limits
Pharmaceutical Manufacturing	RACT: CAA Base Case Extended to Other Areas
Cutback Asphalt	RACT (Switch to Emulsified Asphalt): CAA Base Case Extended to Other Areas
Synthetic Organic Chemical Manufacturing Industry (SOCMI) Batch Reactor Processes	RACT: CAA Base Case Extended to Other Areas
SOCMI Fugitive Emission Leaks	New Control Techniques Guideline (CTG) Document
Petroleum Refinery Fugitive Emission Leaks	RACT: CAA Base Case Extended to Other Areas
Oil and Natural Gas Production Fields	RACT (Equipment/Maintenance): CAA Base Case Extended to Other Areas
Aerosol Paints	California Tier 2 Standards
Aerosol Paints	South Coast Air Quality Management District (SCAQMD) Potential Standards
Pesticides	Reformulate Coatings to Lower VOC Content (Based on California Ozone FIP Rule)
NOx Emissions	
Industrial Coal Combustion	RACT to Small Sources
Industrial Oil Combustion	RACT to Small Sources
Industrial Natural Gas Combustion	RACT to Small Sources
Residential Water Heaters	LNB
Residential Space Heaters	LNB
Open Burning	Episodic Ban
On-Highway Motor Vehicles	
VOC and NOx Emissions	
Light-Duty Gasoline Vehicles and Trucks	California Low Emitting Vehicle (LEV) Program
Light-Duty Gasoline Vehicles and Trucks	Enhanced Inspection and Maintenance Program
Light-Duty Gasoline Vehicles and Trucks	Federal Reformulated Gasoline Program
Light-Duty Gasoline Vehicles and Trucks	California Reformulated Gasoline Program
Light-, Medium-, and Heavy-Duty Vehicles and Trucks	California Reformulated Diesel Program
Nonroad Vehicles	
VOC and NOx Emissions	
2- and 4-Stroke Nonroad Engine Categories	VOC Benefits Associated with Phase I Reformulated Gasoline Program for On-Highway Vehicles
Airport Service Equipment	
Recreational Equipment	
Industrial Equipment	
Logging Equipment (chain saws and shredders)	
Light Commercial/Utility Equipment (generator sets, pumps, air compressors, welders, and pressure washers)	
Construction Equipment (tampers/rammers, plate compactors, rollers, paving equipment, surfacing equipment, signal boards, concrete/ industrial saws, cement and mortar mixers, and dumpers/tenders)	
Farm Equipment (2-wheel tractors, agricultural mowers, sprayers, tillers, and hydro-power units)	
Lawn and Garden Equipment (lawn mowers, tillers, trimmers/edgers/brush	

Table C-1 (continued)

Source Category	Control Measure
cutters, leaf blowers/vacuums, snowblowers, rear engine riding mowers, front mowers, shredders, lawn and garden tractors, wood splitters, chippers/stump grinders, and commercial turf equipment)	

Table C-1 (continued)

Source Category	Control Measure
Nonroad Vehicles (cont'd)	
VOC and NOx Emissions	
≥175 Horsepower Compression Ignition (Diesel) Engines	California Phase II Exhaust Standards
Construction Equipment (scrapers, bore/drill rigs, excavators, cranes, off-highway trucks, rubber tired dozers, and off-highway tractors)	
Logging Equipment (fellers/bunchers)	
Commercial Marine Vessels	Emission fees
Recreational Vehicles	
2-stroke engine category	Potential California Standards
4-stroke engine category	Potential California Standards

Table C-2.SIC Codes and Sectors Affected by the Control Measures for VOC Sources in the Stationary Point Source Inventory

Source Category/SIC Code	SIC Description	Sector
Automobile and Light-Duty Truck Surface Coating (Industrial Surface Coating)		
371	Motor Vehicles and Equipment	Manufacturing
Plastic Parts Surface Coating (Industrial Surface Coating)		
308	Miscellaneous Plastics Products, nec	Manufacturing
Wood Furniture Surface Coating (Wood Product Coating)		
251	Household Furniture	Manufacturing
Flatwood Surface Coating (Wood Product Coating)		
242	Sawmills and Planing Mills	Manufacturing
243	Millwork, Plywood and Structural Members	Manufacturing
249	Miscellaneous Wood Products	Manufacturing
Surface Coating - General/Unspecified		
011	Cash Grains	Agriculture, Forestry, Fishing
203	Preserved Fruits and Vegetables	Manufacturing
243	Millwork, Plywood and Structural Members	Manufacturing
251	Household Furniture	Manufacturing
252	Office Furniture	Manufacturing
291	Petroleum Refining	Manufacturing
295	Asphalt Paving and Roofing Materials	Manufacturing
308	Miscellaneous Plastics Products, nec	Manufacturing
331	Blast Furnace and Basic Steel Products	Manufacturing
332	Iron and Steel Foundries	Manufacturing
339	Miscellaneous Primary Metal Products	Manufacturing
340	Fabricated Metal Products	Manufacturing
341	Metal Cans and Shipping Containers	Manufacturing
342	Cutlery, Handtools, and Hardware	Manufacturing
344	Fabricated Structural Metal Products	Manufacturing
346	Metal Forgings and Stampings	Manufacturing
347	Metal Services, nec	Manufacturing
348	Ordnance and Accessories, nec	Manufacturing
349	Miscellaneous Fabricated Metal Products	Manufacturing
353	Construction and Related Machinery	Manufacturing
358	Refrigeration and Service Machinery	Manufacturing
362	Electrical Industrial Apparatus	Manufacturing
363	Household Appliances	Manufacturing
364	Electric Lighting and Wiring Equipment	Manufacturing
366	Communications Equipment	Manufacturing
367	Electronic Components and Accessories	Manufacturing
370	Transportation Equipment	Manufacturing
371	Motor Vehicles and Equipment	Manufacturing
372	Aircraft and Parts	Manufacturing
373	Ship and Boat Building and Repairing	Manufacturing
376	Guided Missiles, Space Vehicles, Parts	Manufacturing
399	Miscellaneous Manufactures	Manufacturing
458	Airports, Flying Fields, and Services	Transportation and Public Utilities
971	National Security	Public Administration
Rule Effectiveness Improvements		
131	Extraction-Crude Petroleum and Natural Gas	Mining
204	Grain Mill Products	Manufacturing
207	Fats and Oils	Manufacturing
226	Textile Finishing, Except Wool	Manufacturing
Rule Effectiveness Improvements (cont'd)		

Table C-2 (continued)

Source Category/SIC Code	SIC Description	Sector
260	Paper and Allied Products	Manufacturing
262	Paper Mills	Manufacturing
263	Paperboard Mills	Manufacturing
265	Paperboard Containers and Boxes	Manufacturing
267	Miscellaneous Converted Paper Products	Manufacturing
272	Periodicals	Manufacturing
275	Commercial Printing	Manufacturing
281	Industrial Inorganic Chemicals	Manufacturing
282	Plastics Materials and Synthetics	Manufacturing
283	Drugs	Manufacturing
286	Industrial Organic Chemicals	Manufacturing
287	Agricultural Chemicals	Manufacturing
291	Petroleum Refining	Manufacturing
295	Asphalt Paving and Roofing Materials	Manufacturing
299	Miscellaneous Petroleum and Coal Products	Manufacturing
306	Fabricated Rubber Products, nec	Manufacturing
308	Miscellaneous Plastics Products, nec	Manufacturing
329	Miscellaneous Nonmettalic Mineral Products	Manufacturing
331	Blast Furnace and Basic Steel Products	Manufacturing
341	Metal Cans and Shipping Containers	Manufacturing
342	Cutlery, Handtools, and Hardware	Manufacturing
346	Metal Forgings and Stampings	Manufacturing
347	Metal Services, nec	Manufacturing
349	Miscellaneous Fabricated Metal Products	Manufacturing
363	Household Appliances	Manufacturing
371	Motor Vehicles and Equipment and Supplies	Manufacturing
372	Aircraft and Parts	Manufacturing
399	Manufacturing Industries, Miscellaneous	Manufacturing
461	Pipelines, Except Natural Gas	Transportation and Public Utilities
491	Electric Services	Transportation and Public Utilities
493	Combination Utility Services	Transportation and Public Utilities
495	Sanitary Services	Transportation and Public Utilities
509	Miscellaneous Durable Goods	Wholesale Trade
516	Chemicals and Allied Products	Wholesale Trade
517	Petroleum and Petroleum Products	Wholesale Trade
721	Laundry, Cleaning, and Garment Services	Services
971	National Security	Public Administration

Table C-3.SIC Codes and Sectors Affected by Control Measures for NOx Sources in the Stationary Point Source Inventory

Source Category/SIC Code	SIC Description	Sector
Utility Boilers		
491	Electric Services	Transportation and Public Utilities
Industrial Boilers		
201	Meat Products	Manufacturing
203	Preserved Fruits and Vegetables	Manufacturing
213	Chewing and Smoking Tobacco	Manufacturing
221	Broadwoven Fabric Mills, Cotton	Manufacturing
223	Broadwoven Fabric Mills, Wool	Manufacturing
226	Textile Finishing, Except Wool	Manufacturing
229	Miscellaneous Textile Goods	Manufacturing
242	Sawmills and Planing Mills	Manufacturing
252	Office Furniture	Manufacturing
254	Partitions and Fixtures	Manufacturing
261	Pulp Mills	Manufacturing
262	Paper Mills	Manufacturing
263	Paperboard Mills	Manufacturing
267	Miscellaneous Converted Paper Products	Manufacturing
275	Commercial Printing	Manufacturing
281	Industrial Inorganic Chemicals	Manufacturing
282	Plastics Materials and Synthetics	Manufacturing
295	Asphalt Paving and Roofing Materials	Manufacturing
301	Tires and Inner Tubes	Manufacturing
311	Leather Tanning and Finishing	Manufacturing
322	Glass and Glassware, Pressed or Blown	Manufacturing
329	Miscellaneous Nonmettalic Mineral Products	Manufacturing
331	Blast Furnace and Basic Steel Products	Manufacturing
333	Primary Nonferrous Metals	Manufacturing
348	Ordnance and Accessories, nec	Manufacturing
362	Electrical Industrial Apparatus	Manufacturing
371	Motor Vehicles and Equipment	Manufacturing
372	Aircraft and Parts	Manufacturing
373	Ship and Boat Building and Repairing	Manufacturing
806	Hospitals	Services
822	Colleges and Universities	Services
971	National Security	Public Administration
Cement Manufacturing		
324	Cement, Hydraulic	Manufacturing
Glass Manufacturing-Container		
322	Glass -Pressed or Blown	Manufacturing
Gas Turbines		
491	Electric Services	Transportation and Public Utilities
492	Gas Production and Distribution	Transportation and Public Utilities
509	Miscellaneous Durable Goods	Wholesale Trade
Reciprocating IC Engines		
492	Gas Production and Distribution	Transportation and Public Utilities
Process Heaters		
333	Primary Nonferrous Metals	Manufacturing
362	Electrical Industrial Apparatus	Manufacturing
363	Household Appliances	Manufacturing
371	Motor Vehicles and Equipment	Manufacturing
822	Colleges and Universities	Services
Municipal Waste Incinerators		
495	Sanitary Services	Transportation and Public Utilities

Table C-4.SIC Codes and Sectors Affected by Control Measures for NOx and VOC Sources in the Stationary Area Source Inventory

Source Category	SIC Code	SIC Description	Sector
VOC Emissions			
Gasoline Service Stations: Underground Storage Tanks	554	Gasoline Service Stations	Retail Trade
Gasoline Service Stations: Stage I - Truck Unloading	517	Petroleum and Petroleum Products	Wholesale Trade
Bulk Terminals	517	Petroleum and Petroleum Products	Wholesale Trade
Autobody Refinishing	753	Automotive Repair Shops	Services
Aircraft Surface Coating	372	Aircraft and Parts	Manufacturing
Marine Surface Coating	373	Ship and Boat Building and Repairing	Manufacturing
Metal Product Surface Coating	341	Metal Cans and Shipping Containers	Manufacturing
	349	Miscellaneous Fabricated Metal Products	Manufacturing
	371	Motor Vehicles and Equipment	Manufacturing
	375	Motorcycles, Bicycles, and Parts	Manufacturing
	376	Guided Missiles, Space Vehicles, Parts	Manufacturing
	381	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical Systems, Instruments, and Equipment	Manufacturing
	382	Laboratory Apparatus and Analytical, Optical, Measuring, and Controlling Instruments	Manufacturing
	384	Surgical, Medical, and Dental Instruments and Supplies	Manufacturing
	385	Ophthalmic Goods	Manufacturing
	386	Photographic Equipment and Supplies	Manufacturing
	387	Watches, Clocks, Clockwork Operated Devices, and Parts	Manufacturing
	391	Jewelry, Silverware, and Plated War	Manufacturing
	393	Musical Instruments	Manufacturing
	394	Dolls, Toys, Games and Sporting and Athletic Goods	Manufacturing
	395	Pens, Pencils, and Other Artists' Materia	Manufacturing
	396	Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal	Manufacturing
	399	Miscellaneous Manufacturing Industries	Manufacturing
Paper Surface Coating	267	Converted Paper and Paperboard Products, Except Containers and Boxes	Manufacturing
Wood Furniture Surface Coating	251	Household Furniture	Manufacturing
	252	Office Furniture	Manufacturing
	254	Partitions, Shelving, Lockers, and Office and Store Fixtures	Manufacturing
Wood Product Surface Coating	242	Sawmills and Planing Mills	Manufacturing
	243	Millwork, Veneer, Plywood, and Structural Wood Members	Manufacturing
	244	Wood Containers	Manufacturing
	245	Wood Buildings and Mobile Homes	Manufacturing
	249	Miscellaneous Wood Product	Manufacturing

Table C-4 (continued)

Source Category	SIC Code	SIC Description	Sector
Adhesives: Industrial	289	Miscellaneous Chemical Products	Manufacturing

Table C-4 (continued)

Source Category	SIC Code	SIC Description	Sector
VOC Emissions (cont'd)			
Pharmaceutical Manufacturing	283	Drugs	Manufacturing
Miscellaneous Surface Coating	251	Household Furniture	Manufacturing
	252	Office Furniture	Manufacturing
	342	Cutlery, Handtools, and General Hardware	Manufacturing
	343	Plumbing and Heating, Except Electric	Manufacturing
	344	Fabricated Structural Metal Products	Manufacturing
	345	Screw Machine Products, and Bolts, Nuts, Screws, Rivets, and Washers	Manufacturing
	346	Metal Forgings and Stampings	Manufacturing
	347	Metal Services, nec	Manufacturing
	348	Ordnance and Accessories, nec	Manufacturing
	349	Miscellaneous Fabricated Metal Products	Manufacturing
	351	Engines and Turbines	Manufacturing
	352	Farm and Garden Machinery	Manufacturing
	353	Construction and Related Machinery	Manufacturing
	354	Metalworking Machinery and Equipment	Manufacturing
	355	Special Industry Machinery	Manufacturing
	356	General Industrial Machinery	Manufacturing
	357	Computer and Office Equipment	Manufacturing
	358	Refrigeration and Service Machinery	Manufacturing
	359	Miscellaneous Industrial and Commercial Machinery and Equipment	Manufacturing
	361	Electric Distribution Equipment	Manufacturing
	362	Electrical Industrial Apparatus	Manufacturing
	363	Household Appliances	Manufacturing
	364	Electric Lighting and Wiring Equipment	Manufacturing
	365	Household Audio and Video Equipment, and Audio Recordings	Manufacturing
	366	Communications Equipment	Manufacturing
	367	Electronic Components and Accessories	Manufacturing
	369	Miscellaneous Electrical Machinery, Equipment, and Supplies	Manufacturing
	371	Motor Vehicles and Equipment	Manufacturing
	374	Railroad Equipment	Manufacturing
Aerosol Paints	285	Paints, Varnishes, Lacquers, Enamels, and Allied Products	Manufacturing
Pesticides	287	Pesticides and Agricultural Chemicals, n.e.c.	Manufacturing
Synthetic Organic Chemical Manufacturing Industry (SOCMI) Batch Reactor Processes	286	Industrial Organic Chemicals	Manufacturing
SOCMI Fugitive Emission Leaks	286	Industrial Organic Chemicals	Manufacturing

Table C-4 (continued)

Source Category	SIC Code	SIC Description	Sector
VOC Emissions (cont'd)			
Petroleum Refinery Fugitive Emission Leaks	291	Petroleum Refining	Manufacturing
	295	Asphalt Paving and Roofing Materials	Manufacturing
	299	Miscellaneous Petroleum and Coal Products	Manufacturing
Oil and Natural Gas Production Fields	131	Extraction-Crude Petroleum and Natural Gas	Mining
	132	Extraction-Natural Gas Liquids	Mining
	138	Oil and Gas Field Services	Mining
NOx Emissions			
Residential Water Heaters	363	Household Appliances, Miscellaneous	Manufacturing
Residential Space Heaters	343	Heating Equipment, Except Electric and Warm Air Furnaces	Manufacturing

Table C-5.SIC Codes and Sectors Potentially Affected by NOx Control Measures for Industrial Fuel Combustion in the Stationary Area Source Inventory

SIC Code	SIC Description	Sector	Fuel Type: Coal	Fuel Type: Oil	Fuel Type: Natural Gas
131	Extraction-Crude Petroleum and Natural Gas	Mining			✓
144	Sand and Gravel	Mining	✓		
147	Chemical and Fertilizer Minerals	Mining			✓
201	Meat Products	Manufacturing	✓	✓	✓
202	Dairy Products	Manufacturing	✓		✓
203	Preserved Fruits and Vegetables	Manufacturing	✓	✓	✓
204	Grain Mill Products	Manufacturing	✓	✓	✓
205	Bakery Products	Manufacturing		✓	✓
206	Sugar and Confectionery Products	Manufacturing	✓	✓	✓
207	Fats and Oils	Manufacturing	✓	✓	✓
208	Beverages	Manufacturing	✓	✓	✓
209	Miscellaneous Food and Kindred Products	Manufacturing		✓	✓
221	Broadwoven Fabric Mills, Cotton	Manufacturing		✓	
222	Broadwoven Fabric Mills, Manmade Fiber and Silk	Manufacturing			✓
223	Broadwoven Fabric Mills, Wool	Manufacturing		✓	✓
224	Narrow Fabric Mills	Manufacturing		✓	
225	Knitting Mills	Manufacturing	✓		
226	Textile Finishing, Except Wool	Manufacturing	✓	✓	✓
229	Miscellaneous Textile Goods	Manufacturing	✓	✓	✓
233	Women's and Misses' Outerwear	Manufacturing		✓	
243	Millwork, Plywood, and Structural Members	Manufacturing	✓		
249	Miscellaneous Wood Products	Manufacturing		✓	✓
251	Household Furniture	Manufacturing	✓	✓	
262	Paper Mills	Manufacturing	✓	✓	✓
263	Paperboard Mills	Manufacturing			✓
265	Paperboard Containers and Boxes	Manufacturing		✓	✓
267	Miscellaneous Converted Paper Products	Manufacturing	✓	✓	✓
271	Newspapers	Manufacturing		✓	
275	Commercial Printing	Manufacturing		✓	✓
280	Chemicals and Allied Products	Manufacturing			✓
281	Industrial Inorganic Chemicals	Manufacturing	✓	✓	✓
282	Plastics Materials and Synthetics	Manufacturing	✓	✓	✓
283	Drugs	Manufacturing	✓	✓	✓
284	Soaps, Cleaners, and Toilet Goods	Manufacturing	✓	✓	✓
285	Paints and Allied Products	Manufacturing			✓
286	Industrial Organic Chemicals	Manufacturing	✓	✓	✓
287	Agricultural Chemicals	Manufacturing	✓	✓	✓
289	Miscellaneous Chemical Products	Manufacturing	✓	✓	✓
291	Petroleum Refining	Manufacturing			✓
295	Asphalt Paving and Roofing Materials	Manufacturing		✓	✓
299	Miscellaneous Petroleum and Coal Products	Manufacturing			✓
301	Tires and Inner Tubes	Manufacturing	✓	✓	✓
305	Gaskets, Packing, and Sealing Devices and Rubber and Plastic Hose and Belting	Manufacturing		✓	
306	Fabricated Rubber Products, nec	Manufacturing	✓	✓	✓
308	Miscellaneous Plastics Products, nec	Manufacturing	✓	✓	✓
311	Leather Tanning and Finishing	Manufacturing	✓	✓	
322	Glass -Pressed or Blown	Manufacturing			✓
323	Products of Purchased Glass	Manufacturing			✓

Table C-5 (continued)

SIC Code	SIC Description	Sector	Fuel Type: Coal	Fuel Type: Oil	Fuel Type: Natural Gas
324	Cement, Hydraulic	Manufacturing	✓		
325	Structural Clay Products	Manufacturing			✓
326	Pottery and Related Products	Manufacturing	✓		✓
327	Concrete, Gypsum, and Plaster Products	Manufacturing	✓		✓
329	Miscellaneous Nonmetallic Mineral Products	Manufacturing		✓	✓
331	Blast Furnace and Basic Steel Products	Manufacturing	✓	✓	✓
332	Iron and Steel Foundries	Manufacturing			✓
333	Primary Nonferrous Metals	Manufacturing			✓
334	Secondary Nonferrous Metals	Manufacturing	✓	✓	✓
335	Nonferrous Rolling and Drawing	Manufacturing		✓	✓
339	Miscellaneous Primary Metal Products	Manufacturing		✓	✓
341	Metal Cans and Shipping Containers	Manufacturing			✓
342	Cutlery, Handtools, and Hardware	Manufacturing		✓	
343	Plumbing and Heating, Except Electric	Manufacturing		✓	
344	Fabricated Structural Metal Products	Manufacturing		✓	✓
346	Metal Forgings and Stampings	Manufacturing	✓		✓
348	Ordnance and Accessories, nec	Manufacturing		✓	✓
349	Miscellaneous Fabricated Metal Products	Manufacturing			✓
351	Engines and Turbines	Manufacturing	✓	✓	
352	Farm and Garden Machinery	Manufacturing			✓
353	Construction and Related Machinery	Manufacturing	✓	✓	✓
354	Metalworking Machinery	Manufacturing	✓		
356	General Industrial Machinery	Manufacturing		✓	
357	Computer and Office Equipment	Manufacturing		✓	✓
358	Refrigeration and Service Machinery	Manufacturing		✓	✓
359	Miscellaneous Industrial and Commercial Machinery and Equipment	Manufacturing		✓	
361	Electric Distribution Equipment	Manufacturing		✓	✓
362	Electrical Industrial Apparatus	Manufacturing	✓	✓	✓
363	Household Appliances	Manufacturing	✓		✓
364	Electric Lighting and Wiring Equipment	Manufacturing			✓
365	Household Audio and Video Equipment	Manufacturing			✓
366	Communications Equipment	Manufacturing		✓	
367	Electronic Components and Accessories	Manufacturing		✓	✓
369	Miscellaneous Electrical Equipment and Supplies	Manufacturing		✓	
371	Motor Vehicles and Equipment	Manufacturing	✓	✓	✓
372	Aircraft and Parts	Manufacturing		✓	✓
373	Ship and Boat Building and Repairing	Manufacturing		✓	
374	Railroad Equipment	Manufacturing	✓		
376	Guided Missiles, Space Vehicles, Parts	Manufacturing		✓	
384	Medical Instruments and Supplies	Manufacturing		✓	
386	Photographic Equipment and Supplies	Manufacturing		✓	✓
391	Jewelry, Silverware, and Plated Ware	Manufacturing		✓	✓
393	Musical Instruments	Manufacturing		✓	
399	Manufacturing Industries, Miscellaneous	Manufacturing			✓

Table C-6.SIC Codes and Sectors Affected by Control Measures for NOx and VOC Sources in the On-Highway and Nonroad Mobile Source Inventory

Source Category/Control Measure	SIC Code	SIC Description	Sector
On-Highway Motor Vehicles			
Federal and California Reformulated Gasoline Programs	291	Petroleum Refineries	Manufacturing
California Reformulated Diesel Fuel Program	291	Petroleum Refineries	Manufacturing
California Low Emission Vehicle Programs	371	Motor Vehicles and Equipment	Manufacturing
	551	New and Used Car Dealers	Retail Trade
Enhanced I/M	554	Gasoline Service Stations	Retail Trade
		Households	
	753	Automotive Repair Shops	Services
Nonroad Motor Vehicles			
Federal Reformulated Gasoline Program	291	Petroleum Refineries	Manufacturing
California Phase II Exhaust Standards for Nonroad Diesel Engines ≥175 hp	351	Internal Combustion Engines, not elsewhere classified	Manufacturing
Commercial Marine Vessels, Emission Fees[1]	444	Water Transportation of Freight, Not Elsewhere Classified	Water Transportation
Recreational Vehicles - Potential California Standards for 2- and 4-stroke engines	375	Motorcycles, Bicycles, and Parts	Manufacturing
	379	Transportation Equipment, Not Elsewhere Classified	Manufacturing

[1]This control measure could potentially affect SIC codes 441, 442, and 443. However, the County Business Patterns did not report any establishments for these SIC codes for the nonattainment area counties for which control costs were estimated. Consequently, these three SIC codes were not included in the economic impact analysis for this control measure.

APPENDIX D

ECONOMIC IMPACT ASSESSMENT SUPPORTING INFORMATION

TABLE D-1
Control Measures and SIC Codes Excluded from the Analysis

Source Category, Control Measure, or SIC code	Reason for Exclusion
Residential Natural Gas Consumption / Low-NOx Burners (LNB) for Water Heaters	Costs are 0
Point Source Open Burning / Episodic Ban	Costs are 0
Area Source Open Burning / Episodic Ban	Costs are 0
Service Stations: Stage I Truck Unloading/Vapor Balance	Vapor recovery credits will offset equipment installation and operation costs.
Petroleum Refinery Fugitives / RACT	Costs are negative (1)
Web Offset Lithography / New CTG (carbon adsorber)	Costs are negative (1)
Cutback Asphalt / Switch to Emulsified Asphalt	Costs are 0
Point Source Metal Surface Coating/FIP VOC limits	Costs are 0
Residential Natural Gas Combustion/LNB for Space Heaters	NA (2)
SIC code 257	SIC code miscoded in Interim 1990 Point Source Inventory
SIC code 928	SIC code miscoded in Interim 1990 Point Source Inventory

(1) Negative costs for VOC measures are due either to recovery credits for reduced VOC use and/or production cost savings.

(2) No establishments were reported in County Business Patters for the counties for which this control measure was selected; consequently, average costs per establishment and cost-to-sales ratios could not be calculated for SIC code 3433.

TABLE D-2
Sources of Data Used in Screening Analysis
Methodology by Source Category

Source Category	Industries/Entities Affected	Number of Affected Entities by SIC Code	Cost Data Used in Analysis	Sales Data Used in Analysis
Stationary Point Sources				
Non-Government Point Source Categories	Interim 1990 Inventory (a)	Interim 1990 Inventory (b)	Average cost per plant	Enterprise Statistics (c)
Non-Defense Government Point Source Categories	Interim 1990 Inventory	Affected counties listed in Interim 1990 Inventory	Total cost for all affected plants in a county	Census of Government
National Defense Related Point Source Categories	Interim 1990 Inventory	1 (Federal government)	Total cost for all affected plants	Census of Government
Stationary Area Sources				
Area Source Industrial Fuel Combustion	National Emissions Inventory (d)	Not calculated	(e)	Enterprise Statistics (c)
Bulk Terminals	Petroleum and Petroleum Products	Not calculated	(f)	Enterprise Statistics (c)
Industrial Adhesives	Product Manufacturers	Not calculated	(f)	Enterprise Statistics (c)
Surface Coating	Product Manufacturers	Not calculated	(f)	Enterprise Statistics (c)
Automobile Refinishing	Automobile Repair/Paint Shops	County Business Patterns: affected county total	Average cost per affected establishment	Enterprise Statistics (c)
Pesticide Application	Product Manufacturers	County Business Patterns: affected county total	Average cost per affected establishment	Enterprise Statistics (c)
Aerosol Paints	Product Manufacturers	Data from CARB (g)	Average cost per affected establishment	Enterprise Statistics (c)
SOCMI Batch Reactor Processes	Product Manufacturers	County Business Patterns: affected county total	Average cost per affected establishment	Enterprise Statistics (c)
SOCMI Fugitives	Product Manufacturers	County Business Patterns: affected county total	Average cost per affected establishment	Enterprise Statistics (c)
Pharmaceutical manufacturing	Product Manufacturers	County Business Patterns: affected county total	Average cost per affected establishment	Enterprise Statistics (c)
Oil/Natural Gas Field Production	Oil/Gas Extraction	County Business Patterns: affected county total	Average cost per affected establishment	Enterprise Statistics (c)
Service Stations - P-V Valves	Gasoline Service Stations	County Business Patterns: affected county total	Average cost per affected establishment	Enterprise Statistics (c)
On-Highway Motor Vehicles				
Low Emission Vehicles	Automobile Manufacturers	County Business Patterns: national total	Average cost per manufacturer	Enterprise Statistics (c)
Reformulated Gasoline	Petroleum Refineries	(h)	Average cost per affected refinery	Enterprise Statistics (c)
Reformulated Diesel Fuel	Petroleum Refineries	(i)	Average cost per affected refinery	Enterprise Statistics (c)
Enhanced I/M	(j)	(j)	(j)	(j)
Nonroad Vehicles				
Recreational Vehicles (CARB Standards)	Equipment Manufacturers	County Business Patterns: affected county total (k)	Average cost per affected establishment	Enterprise Statistics (c)
Commercial Marine Vessels	Water Transportation	County Business Patterns: affected county total	Average cost per affected establishment	Enterprise Statistics (c)
Nonroad Diesels (> 175 HP)	Equipment Manufacturers	County Business Patterns: affected county total (k)	Average cost per affected establishment	Enterprise Statistics (c)

TABLE D-2
Sources of Data Used in Screening Analysis Methodology by Source Category

Source Category	Industries/Entities Affected	Number of Affected Entities by SIC Code	Cost Data Used in Analysis	Sales Data Used in Analysis
Nonroad Gasoline	Petroleum Refineries	(h)	Average cost per affected refinery	Enterprise Statistics (c)

TABLE D-2 NOTES:

(a)A default SIC code has been identified for each stationary point source category to be used if no SIC code is identified in the Interim 1990 Inventory. The default value represents the SIC code appearing most frequently in the Interim 1990 Inventory for each affected source category.

(b) For these stationary point source categories, the total number of affected establishments represents the total number of plants in the Interim 1990 Inventory.

(c) The Enterprise Statistics data base contains 3-digit SIC code sales data from the Bureau of the Census. The data base also contains sales data that have been collected from other Census publications (e.g., Census of Agriculture).

(d) The NOx control measures for area source industrial fuel combustion represent the expansion of the application of a corresponding incremental point source measure. The point source SCCs were applied to NEI data to identify the range of SIC codes that would likely be affected by these area source control measures.

(e) A cost per establishment was calculated by multiplying the control measure's cost effectiveness ($/ton) by its emission reduction. A measure's emission reduction was estimated by multiplying 80% rule effectiveness times the applicable control efficiency times the total uncontrolled NOx emissions at plants in the NEI with emissions between 25-100 tpy, and then dividing this total by the number of plants with emissions between 25-100 tpy.

(f) The SIC codes identified as potentially being affected by the VOC control measures were used to identify plants in the NEI with uncontrolled emissions between 25 and 100 tons per year. The method explained in footnote (e) was then used to calculate the average cost per establishment for each control measure.

(g) CARB completed a survey and determined that 70 nationwide paint manufacturers would be affected by the California rule on which this measure is based.

(h) The estimation of the number of refineries affected by the reformulated gasoline control measures is a two-step process. First, the number of refineries producing gasoline was estimated by using survey results from EPA on the proportion of a refinery sample that produces gasoline. This percentage was applied to the total number of operating refineries based on published DOE data. Second, the proportion of total U.S. gasoline consumption represented by affected nonattainment areas was applied to the number of refineries that produce gasoline.

(I) The number of refineries affected by the reformulated diesel control measure was estimated using an approach similar to footnote (h). First, the proportion of refineries producing diesel fuel was obtained from EPA survey data. Second, the proportion of total U.S. diesel consumption represented by affected nonattainment area counties was applied to the number of refineries that produce diesel fuel.

(j) The analysis of the enhanced I/M program is based on the approach used in the California FIP analysis.

(k) Since the affected industries are only a subset of the 4-digit SIC code, the total number of affected establishments in County Business Patterns was weighted by the ratio of the value of shipments for the affected equipment to the total value of shipments for the affected SIC code.

TABLE D-3
8H5EX-80 NAAQS Alternative
Cost-to-Sales Ratios by Control Measure and SIC Code for All and Small Establishments
(in thousands of $1990)

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Stationary Point Sources								
Cement Manufacturing - Dry	SCR	324	1	$2,280	$27,047	$8,944	8.4%	25.5%
Glass Mfg - Container	Oxy-Firing	322	1	$4,775	$22,318	$1,275	21.4%	374.5%
Ind. Boiler - Distillate Oil	SCR	267	1	$13	$17,201	$4,114	0.1%	0.3%
Ind. Boiler - Distillate Oil	SCR	282	1	$13	$111,791	$16,963	0.0%	0.1%
Ind. Boiler - Distillate Oil	SCR	322	1	$13	$22,318	$1,275	0.1%	1.0%
Ind. Boiler - Distillate Oil	SCR	331	1	$13	$49,452	$5,095	0.0%	0.3%
Ind. Boiler - Natural Gas	SCR	267	1	$116	$17,201	$4,114	0.7%	2.8%
Ind. Boiler - Natural Gas	SCR	282	1	$116	$111,791	$16,963	0.1%	0.7%
Ind. Boiler - Natural Gas	SCR	295	1	$116	$6,445	$4,657	1.8%	2.5%
Ind. Boiler - Natural Gas	SCR	322	1	$116	$22,318	$1,275	0.5%	9.1%
Ind. Boiler - Natural Gas	SCR	331	1	$116	$49,452	$5,095	0.2%	2.3%
Ind. Boiler - Residual Oil	SCR	282	1	$47	$111,791	$16,963	0.0%	0.3%
Ind. Boiler - Residual Oil	SCR	295	1	$47	$6,445	$4,657	0.7%	1.0%
Ind. Boiler - Residual Oil	SCR	371	1	$47	$38,564	$2,267	0.1%	2.1%
Point Source Ind. Surface Coating	Add-on Control Levels	376	1	$3,328	$316,586	$5,142	1.1%	64.7%
Point Source Ind. Surface Coating	Add-on Control Levels	971	1	$3,328	$475,435,160		0.0%	
Point Sources	RE	131	2	$707	$7,430	$3,265	9.5%	21.7%
Point Sources	RE	207	2	$707	$43,948	$21,299	1.6%	3.3%
Point Sources	RE	282	1	$707	$111,791	$16,963	0.6%	4.2%
Point Sources	RE	286	2	$707	$90,160	$13,860	0.8%	5.1%
Point Sources	RE	287	1	$707	$9,998	$3,481	7.1%	20.3%
Point Sources	RE	291	1	$707	$553,301	$42,456	0.1%	1.7%
Point Sources	RE	295	1	$707	$6,445	$4,657	11.0%	15.2%
Point Sources	RE	495	1	$707	$4,108	$2,936	17.2%	24.1%
Point Sources	RE	721	1	$707	$408	$278	173.5%	254.2%
Utility Boiler - Oil-Gas/Tangential	SCR	491	1	$2,424	$33,269	$10,705	7.3%	22.6%
Stationary Area Sources								
Adhesives - industrial	RACT	289	3	$1	$8,863	$5,318	0.0%	0.0%
Aerosols	SCAQMD Standards - Reformulati	285	70	$73	$13,724	$6,287	0.5%	1.2%
Area Source Ind. NG Comb	RACT (small)	131	2	$9	$7,430	$3,265	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	201	32	$9	$19,290	$5,527	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	202	14	$9	$13,315	$5,007	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	203	12	$9	$11,814	$3,495	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	204	15	$9	$9,583	$3,428	0.1%	0.3%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Area Source Ind. NG Comb	RACT (small)	205	32	$9	$6,172	$1,208	0.2%	0.8%
Area Source Ind. NG Comb	RACT (small)	206	6	$9	$7,010	$2,669	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	207	5	$9	$43,948	$21,299	0.0%	0.0%
Area Source Ind. NG Comb	RACT (small)	208	18	$9	$14,053	$3,686	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	209	38	$9	$10,134	$3,348	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	222	3	$9	$17,327	$2,548	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	223	1	$9	$22,019	$2,238	0.0%	0.4%
Area Source Ind. NG Comb	RACT (small)	226	10	$9	$13,299	$2,913	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	229	14	$9	$8,724	$2,628	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	249	34	$9	$3,325	$1,862	0.3%	0.5%
Area Source Ind. NG Comb	RACT (small)	263	3	$9	$96,730	$21,071	0.0%	0.0%
Area Source Ind. NG Comb	RACT (small)	265	59	$9	$13,215	$5,965	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	267	52	$9	$17,201	$4,114	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	275	526	$9	$2,058	$1,120	0.4%	0.8%
Area Source Ind. NG Comb	RACT (small)	280	226	$9	$21,178	$4,833	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	281	20	$9	$22,955	$7,204	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	282	7	$9	$111,791	$16,963	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	283	12	$9	$22,363	$3,008	0.0%	0.3%
Area Source Ind. NG Comb	RACT (small)	284	56	$9	$12,882	$2,980	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	285	32	$9	$13,724	$6,287	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	286	11	$9	$90,160	$13,860	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	287	5	$9	$9,998	$3,481	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	289	65	$9	$8,863	$5,318	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	291	3	$9	$553,301	$42,456	0.0%	0.0%
Area Source Ind. NG Comb	RACT (small)	295	28	$9	$6,445	$4,657	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	299	4	$9	$9,142	$6,903	0.1%	0.1%
Area Source Ind. NG Comb	RACT (small)	301	2	$9	$99,723	$3,747	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	306	11	$9	$9,416	$3,076	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	308	152	$9	$5,716	$2,556	0.2%	0.4%
Area Source Ind. NG Comb	RACT (small)	322	2	$9	$22,318	$1,275	0.0%	0.7%
Area Source Ind. NG Comb	RACT (small)	323	18	$9	$5,523	$1,746	0.2%	0.5%
Area Source Ind. NG Comb	RACT (small)	325	5	$9	$6,826	$3,735	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	326	8	$9	$3,426	$859	0.3%	1.1%
Area Source Ind. NG Comb	RACT (small)	327	124	$9	$3,400	$2,338	0.3%	0.4%
Area Source Ind. NG Comb	RACT (small)	329	18	$9	$8,551	$2,894	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	331	9	$9	$49,452	$5,095	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	332	5	$9	$8,205	$1,747	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	333	1	$9	$74,465	$4,050	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	334	5	$9	$13,040	$8,343	0.1%	0.1%
Area Source Ind. NG Comb	RACT (small)	335	17	$9	$36,514	$6,961	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	339	3	$9	$3,490	$2,182	0.3%	0.4%
Area Source Ind. NG Comb	RACT (small)	341	8	$9	$30,750	$10,316	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	344	152	$9	$4,375	$2,469	0.2%	0.4%
Area Source Ind. NG Comb	RACT (small)	346	25	$9	$9,507	$2,730	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	348	3	$9	$11,888	$1,003	0.1%	0.9%
Area Source Ind. NG Comb	RACT (small)	349	84	$9	$4,404	$1,989	0.2%	0.5%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Area Source Ind. NG Comb	RACT (small)	352	13	$9	$7,232	$1,480	0.1%	0.6%
Area Source Ind. NG Comb	RACT (small)	353	29	$9	$6,416	$2,160	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	357	36	$9	$15,064	$2,497	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	358	23	$9	$15,967	$2,683	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	361	15	$9	$15,868	$2,716	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	362	11	$9	$10,107	$1,967	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	363	3	$9	$15,823	$1,850	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	364	13	$9	$13,071	$2,463	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	365	7	$9	$8,303	$1,766	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	367	56	$9	$7,130	$1,627	0.1%	0.6%
Area Source Ind. NG Comb	RACT (small)	371	52	$9	$38,564	$2,267	0.0%	0.4%
Area Source Ind. NG Comb	RACT (small)	372	11	$9	$80,938	$2,963	0.0%	0.3%
Area Source Ind. NG Comb	RACT (small)	386	11	$9	$18,748	$2,271	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	391	4	$9	$2,468	$1,090	0.4%	0.8%
Area Source Ind. NG Comb	RACT (small)	399	76	$9	$1,858	$1,009	0.5%	0.9%
Automobile refinishing	FIP Rule	753	1469	$11	$473	$454	2.3%	2.3%
Bulk Terminals	RACT	517	40	$1	$9,839	$8,410	0.0%	0.0%
Metal prod. surface coating	VOC limits	373	43	$841	$9,088	$1,459	9.3%	57.7%
Metal prod. surface coating	VOC limits	341	3	$1	$30,750	$10,316	0.0%	0.0%
Metal prod. surface coating	VOC limits	349	49	$1	$4,404	$1,989	0.0%	0.0%
Metal prod. surface coating	VOC limits	371	46	$1	$38,564	$2,267	0.0%	0.0%
Metal prod. surface coating	VOC limits	375	4	$1	$7,336	$2,049	0.0%	0.0%
Metal prod. surface coating	VOC limits	376	2	$1	$316,586	$5,142	0.0%	0.0%
Metal prod. surface coating	VOC limits	381	8	$1	$50,989	$2,025	0.0%	0.0%
Metal prod. surface coating	VOC limits	382	22	$1	$9,496	$2,342	0.0%	0.0%
Metal prod. surface coating	VOC limits	384	27	$1	$10,100	$2,241	0.0%	0.0%
Metal prod. surface coating	VOC limits	385	4	$1	$12,731	$2,587	0.0%	0.0%
Metal prod. surface coating	VOC limits	386	4	$1	$18,748	$2,271	0.0%	0.0%
Metal prod. surface coating	VOC limits	387	2	$1	$18,684	$2,833	0.0%	0.0%
Metal prod. surface coating	VOC limits	391	6	$1	$2,468	$1,090	0.0%	0.1%
Metal prod. surface coating	VOC limits	393	1	$1	$2,545	$1,225	0.0%	0.1%
Metal prod. surface coating	VOC limits	394	23	$1	$4,191	$1,938	0.0%	0.0%
Metal prod. surface coating	VOC limits	395	10	$1	$3,227	$1,294	0.0%	0.1%
Metal prod. surface coating	VOC limits	396	1	$1	$2,604	$1,126	0.0%	0.1%
Metal prod. surface coating	VOC limits	399	56	$1	$1,858	$1,009	0.0%	0.1%
Misc. surface coating	Add-on control	251	34	$539	$5,396	$1,773	10.0%	30.4%
Misc. surface coating	Add-on control	252	9	$539	$12,698	$2,271	4.2%	23.7%
Misc. surface coating	Add-on control	342	10	$539	$7,887	$2,003	6.8%	26.9%
Misc. surface coating	Add-on control	343	12	$539	$8,638	$2,429	6.2%	22.2%
Misc. surface coating	Add-on control	344	142	$539	$4,375	$2,469	12.3%	21.8%
Misc. surface coating	Add-on control	345	1	$539	$3,649	$2,234	14.8%	24.1%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Misc. surface coating	Add-on control	346	14	$539	$9,507	$2,730	5.7%	19.7%
Misc. surface coating	Add-on control	347	34	$539	$2,015	$1,371	26.7%	39.3%
Misc. surface coating	Add-on control	349	66	$539	$4,404	$1,989	12.2%	27.1%
Misc. surface coating	Add-on control	363	4	$539	$15,823	$1,850	3.4%	29.1%
Misc. surface coating	Add-on control	371	50	$539	$38,564	$2,267	1.4%	23.8%
Misc. surface coating	MACT control	352	31	$29	$7,232	$1,480	0.4%	2.0%
Misc. surface coating	MACT control	353	17	$29	$6,416	$2,160	0.5%	1.4%
Misc. surface coating	MACT control	354	24	$29	$2,260	$1,154	1.3%	2.6%
Misc. surface coating	MACT control	355	22	$29	$3,761	$1,743	0.8%	1.7%
Misc. surface coating	MACT control	356	24	$29	$5,377	$2,069	0.6%	1.4%
Misc. surface coating	MACT control	357	13	$29	$15,064	$2,497	0.2%	1.2%
Misc. surface coating	MACT control	358	19	$29	$15,967	$2,683	0.2%	1.1%
Misc. surface coating	MACT control	359	103	$29	$1,171	$769	2.5%	3.8%
Misc. surface coating	MACT control	361	4	$29	$15,868	$2,716	0.2%	1.1%
Misc. surface coating	MACT control	362	5	$29	$10,107	$1,967	0.3%	1.5%
Misc. surface coating	MACT control	363	4	$29	$15,823	$1,850	0.2%	1.6%
Misc. surface coating	MACT control	364	9	$29	$13,071	$2,463	0.2%	1.2%
Misc. surface coating	MACT control	365	8	$29	$8,303	$1,766	0.4%	1.7%
Misc. surface coating	MACT control	366	17	$29	$12,188	$2,437	0.2%	1.2%
Misc. surface coating	MACT control	367	39	$29	$7,130	$1,627	0.4%	1.8%
Misc. surface coating	MACT control	369	12	$29	$12,090	$1,472	0.2%	2.0%
Paper surface coating	Add-on control	267	14	$2,635	$17,201	$4,114	15.3%	64.0%
Pesticide Application	Reform - FIP rule	287	17	$377	$9,998	$3,481	3.8%	10.8%
Service stations - stage I-truck un	P-V valves	554	862	$0	$1,458	$1,191	0.0%	0.0%
Wood furniture surf coating	Reformulation	251	30	$11	$5,396	$1,773	0.2%	0.6%
Wood furniture surf coating	Reformulation	252	9	$11	$12,698	$2,271	0.1%	0.5%
Wood furniture surf coating	Reformulation	254	13	$11	$3,779	$1,958	0.3%	0.6%
Wood furniture surf coating	Reformulation	242	35	$1	$4,830	$2,310	0.0%	0.0%
Wood furniture surf coating	Reformulation	243	140	$1	$4,640	$1,918	0.0%	0.0%
Wood furniture surf coating	Reformulation	244	22	$1	$1,666	$1,298	0.1%	0.1%
Wood furniture surf coating	Reformulation	245	16	$1	$9,840	$3,971	0.0%	0.0%
Wood furniture surf coating	Reformulation	249	27	$1	$3,325	$1,862	0.0%	0.1%
Nonroad Vehicles								
Nonroad gasoline	Reform. gas	291	1	$775	$553,301	$42,456	0.1%	1.8%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Recreational vehicles	CARB stds	375	2	$13	$7,336	$2,049	0.2%	0.6%
Recreational vehicles	CARB stds	379	7	$13	$9,164	$2,426	0.1%	0.5%
Onroad Vehicles								
Motor Vehicles	Cal. Reform	291	2	$76,891	$553,301	$42,456	13.9%	181.1%
Motor Vehicles	Fed. Reform	291	1	$10,593	$553,301	$42,456	1.9%	25.0%
Motor Vehicles	Reform Diesel	291	1	$25,282	$553,301	$42,456	4.6%	59.6%

TABLE D-4
8H4AX-80 NAAQS Alternative:
Cost-to-Sales Ratios by Control Measure and SIC Code for All and Small Establishments
(in thousands of $1990)

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Stationary Point Sources								
Cement Manufacturing - Dry	SCR	324	1	$2,280	$27,047	$8,944	8.4%	25.5%
Glass Mfg - Container	Oxy-Firing	322	1	$4,775	$22,318	$1,275	21.4%	374.5%
Ind. Boiler - Distillate Oil	SCR	267	1	$13	$17,201	$4,114	0.1%	0.3%
Ind. Boiler - Distillate Oil	SCR	282	1	$13	$111,791	$16,963	0.0%	0.1%
Ind. Boiler - Distillate Oil	SCR	322	1	$13	$22,318	$1,275	0.1%	1.0%
Ind. Boiler - Distillate Oil	SCR	331	1	$13	$49,452	$5,095	0.0%	0.3%
Ind. Boiler - Natural Gas	SCR	267	1	$116	$17,201	$4,114	0.7%	2.8%
Ind. Boiler - Natural Gas	SCR	282	1	$116	$111,791	$16,963	0.1%	0.7%
Ind. Boiler - Natural Gas	SCR	295	1	$116	$6,445	$4,657	1.8%	2.5%
Ind. Boiler - Natural Gas	SCR	322	1	$116	$22,318	$1,275	0.5%	9.1%
Ind. Boiler - Natural Gas	SCR	331	1	$116	$49,452	$5,095	0.2%	2.3%
Ind. Boiler - Residual Oil	SCR	282	1	$47	$111,791	$16,963	0.0%	0.3%
Ind. Boiler - Residual Oil	SCR	295	1	$47	$6,445	$4,657	0.7%	1.0%
Ind. Boiler - Residual Oil	SCR	371	1	$47	$38,564	$2,267	0.1%	2.1%
Point Source Ind. Surface Coating	Add-on Control Levels	203	1	$9,196	$11,814	$3,495	77.8%	263.1%
Point Source Ind. Surface Coating	Add-on Control Levels	291	1	$9,196	$553,301	$42,456	1.7%	21.7%
Point Source Ind. Surface Coating	Add-on Control Levels	342	1	$9,196	$7,887	$2,003	116.6%	459.1%
Point Source Ind. Surface Coating	Add-on Control Levels	344	1	$9,196	$4,375	$2,469	210.2%	372.5%
Point Source Ind. Surface Coating	Add-on Control Levels	346	1	$9,196	$9,507	$2,730	96.7%	336.9%
Point Source Ind. Surface Coating	Add-on Control Levels	364	1	$9,196	$13,071	$2,463	70.4%	373.4%
Point Source Ind. Surface Coating	Add-on Control Levels	371	2	$9,196	$38,564	$2,267	23.9%	405.7%
Point Source Ind. Surface Coating	Add-on Control Levels	376	1	$9,196	$316,586	$5,142	2.9%	178.8%
Point Source Ind. Surface Coating	Add-on Control Levels	971	2	$9,196	$475,435,160		0.0%	
Point Source Wood Product Coating	FIP VOC Limits	251	1	$4	$5,396	$1,773	0.1%	0.2%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Point Source Wood Product Coating	FIP VOC Limits	349	1	$4	$4,404	$1,989	0.1%	0.2%
Point Sources	RE	131	2	$2,128	$7,430	$3,265	28.6%	65.2%
Point Sources	RE	207	2	$2,128	$43,948	$21,299	4.8%	10.0%
Point Sources	RE	263	1	$2,128	$96,730	$21,071	2.2%	10.1%
Point Sources	RE	265	1	$2,128	$13,215	$5,965	16.1%	35.7%
Point Sources	RE	267	3	$2,128	$17,201	$4,114	12.4%	51.7%
Point Sources	RE	275	2	$2,128	$2,058	$1,120	103.4%	190.0%
Point Sources	RE	282	5	$2,128	$111,791	$16,963	1.9%	12.5%
Point Sources	RE	286	8	$2,128	$90,160	$13,860	2.4%	15.4%
Point Sources	RE	287	2	$2,128	$9,998	$3,481	21.3%	61.1%
Point Sources	RE	291	4	$2,128	$553,301	$42,456	0.4%	5.0%
Point Sources	RE	295	1	$2,128	$6,445	$4,657	33.0%	45.7%
Point Sources	RE	299	1	$2,128	$9,142	$6,903	23.3%	30.8%
Point Sources	RE	308	2	$2,128	$5,716	$2,556	37.2%	83.2%
Point Sources	RE	329	1	$2,128	$8,551	$2,894	24.9%	73.5%
Point Sources	RE	342	1	$2,128	$7,887	$2,003	27.0%	106.2%
Point Sources	RE	346	1	$2,128	$9,507	$2,730	22.4%	77.9%
Point Sources	RE	347	1	$2,128	$2,015	$1,371	105.6%	155.2%
Point Sources	RE	399	1	$2,128	$1,858	$1,009	114.5%	210.9%
Point Sources	RE	491	1	$2,128	$33,269	$10,705	6.4%	19.9%
Point Sources	RE	495	1	$2,128	$4,108	$2,936	51.8%	72.5%
Point Sources	RE	509	1	$2,128	$5,706	$2,587	37.3%	82.2%
Point Sources	RE	517	6	$2,128	$9,839	$8,410	21.6%	25.3%
Point Sources	RE	721	1	$2,128	$408	$278	522.1%	765.1%
Point Sources	RE	971	1	$2,128	$475,435,160		0.0%	
Utility Boiler - Oil-Gas/Tangential	SCR	491	1	$2,424	$33,269	$10,705	7.3%	22.6%
Stationary Area Sources								
Adhesives - industrial	RACT	289	3	$1	$8,863	$5,318	0.0%	0.0%
Aerosols	CARB Tier 2 Standards - Reform	285	70	$2	$13,724	$6,287	0.0%	0.0%
Aerosols	SCAQMD Standards - Reformulati	285	70	$233	$13,724	$6,287	1.7%	3.7%
Aircraft surface coating	Add-on control	372	21	$1,392	$80,938	$2,963	1.7%	47.0%
Area Source Ind. NG Comb	RACT (small)	131	2	$9	$7,430	$3,265	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	201	32	$9	$19,290	$5,527	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	202	14	$9	$13,315	$5,007	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	203	12	$9	$11,814	$3,495	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	204	15	$9	$9,583	$3,428	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	205	32	$9	$6,172	$1,208	0.2%	0.8%
Area Source Ind. NG Comb	RACT (small)	206	6	$9	$7,010	$2,669	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	207	5	$9	$43,948	$21,299	0.0%	0.0%
Area Source Ind. NG Comb	RACT (small)	208	18	$9	$14,053	$3,686	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	209	38	$9	$10,134	$3,348	0.1%	0.3%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Area Source Ind. NG Comb	RACT (small)	222	3	$9	$17,327	$2,548	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	223	1	$9	$22,019	$2,238	0.0%	0.4%
Area Source Ind. NG Comb	RACT (small)	226	10	$9	$13,299	$2,913	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	229	14	$9	$8,724	$2,628	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	249	34	$9	$3,325	$1,862	0.3%	0.5%
Area Source Ind. NG Comb	RACT (small)	263	3	$9	$96,730	$21,071	0.0%	0.0%
Area Source Ind. NG Comb	RACT (small)	265	59	$9	$13,215	$5,965	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	267	52	$9	$17,201	$4,114	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	275	526	$9	$2,058	$1,120	0.4%	0.8%
Area Source Ind. NG Comb	RACT (small)	280	226	$9	$21,178	$4,833	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	281	20	$9	$22,955	$7,204	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	282	7	$9	$111,791	$16,963	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	283	12	$9	$22,363	$3,008	0.0%	0.3%
Area Source Ind. NG Comb	RACT (small)	284	56	$9	$12,882	$2,980	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	285	32	$9	$13,724	$6,287	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	286	11	$9	$90,160	$13,860	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	287	5	$9	$9,998	$3,481	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	289	65	$9	$8,863	$5,318	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	291	3	$9	$553,301	$42,456	0.0%	0.0%
Area Source Ind. NG Comb	RACT (small)	295	28	$9	$6,445	$4,657	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	299	4	$9	$9,142	$6,903	0.1%	0.1%
Area Source Ind. NG Comb	RACT (small)	301	2	$9	$99,723	$3,747	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	306	11	$9	$9,416	$3,076	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	308	152	$9	$5,716	$2,556	0.2%	0.4%
Area Source Ind. NG Comb	RACT (small)	322	2	$9	$22,318	$1,275	0.0%	0.7%
Area Source Ind. NG Comb	RACT (small)	323	18	$9	$5,523	$1,746	0.2%	0.5%
Area Source Ind. NG Comb	RACT (small)	325	5	$9	$6,826	$3,735	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	326	8	$9	$3,426	$859	0.3%	1.1%
Area Source Ind. NG Comb	RACT (small)	327	124	$9	$3,400	$2,338	0.3%	0.4%
Area Source Ind. NG Comb	RACT (small)	329	18	$9	$8,551	$2,894	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	331	9	$9	$49,452	$5,095	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	332	5	$9	$8,205	$1,747	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	333	1	$9	$74,465	$4,050	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	334	5	$9	$13,040	$8,343	0.1%	0.1%
Area Source Ind. NG Comb	RACT (small)	335	17	$9	$36,514	$6,961	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	339	3	$9	$3,490	$2,182	0.3%	0.4%
Area Source Ind. NG Comb	RACT (small)	341	8	$9	$30,750	$10,316	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	344	152	$9	$4,375	$2,469	0.2%	0.4%
Area Source Ind. NG Comb	RACT (small)	346	25	$9	$9,507	$2,730	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	348	3	$9	$11,888	$1,003	0.1%	0.9%
Area Source Ind. NG Comb	RACT (small)	349	84	$9	$4,404	$1,989	0.2%	0.5%
Area Source Ind. NG Comb	RACT (small)	352	13	$9	$7,232	$1,480	0.1%	0.6%
Area Source Ind. NG Comb	RACT (small)	353	29	$9	$6,416	$2,160	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	357	36	$9	$15,064	$2,497	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	358	23	$9	$15,967	$2,683	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	361	15	$9	$15,868	$2,716	0.1%	0.3%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Area Source Ind. NG Comb	RACT (small)	362	11	$9	$10,107	$1,967	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	363	3	$9	$15,823	$1,850	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	364	13	$9	$13,071	$2,463	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	365	7	$9	$8,303	$1,766	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	367	56	$9	$7,130	$1,627	0.1%	0.6%
Area Source Ind. NG Comb	RACT (small)	371	52	$9	$38,564	$2,267	0.0%	0.4%
Area Source Ind. NG Comb	RACT (small)	372	11	$9	$80,938	$2,963	0.0%	0.3%
Area Source Ind. NG Comb	RACT (small)	386	11	$9	$18,748	$2,271	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	391	4	$9	$2,468	$1,090	0.4%	0.8%
Area Source Ind. NG Comb	RACT (small)	399	76	$9	$1,858	$1,009	0.5%	0.9%
Automobile refinishing	FIP Rule (VOC Content & TE)	753	4644	$13	$473	$454	2.7%	2.8%
Bulk Terminals	RACT	517	114	$4	$9,839	$8,410	0.0%	0.0%
Marine Surface Coating	Add-on control	373	77	$810	$9,088	$1,459	8.9%	55.5%
Metal prod. surface coating	VOC limits	341	29	$1	$30,750	$10,316	0.0%	0.0%
Metal prod. surface coating	VOC limits	349	385	$1	$4,404	$1,989	0.0%	0.0%
Metal prod. surface coating	VOC limits	371	176	$1	$38,564	$2,267	0.0%	0.0%
Metal prod. surface coating	VOC limits	375	10	$1	$7,336	$2,049	0.0%	0.0%
Metal prod. surface coating	VOC limits	376	5	$1	$316,586	$5,142	0.0%	0.0%
Metal prod. surface coating	VOC limits	381	50	$1	$50,989	$2,025	0.0%	0.0%
Metal prod. surface coating	VOC limits	382	217	$1	$9,496	$2,342	0.0%	0.0%
Metal prod. surface coating	VOC limits	384	181	$1	$10,100	$2,241	0.0%	0.0%
Metal prod. surface coating	VOC limits	385	21	$1	$12,731	$2,587	0.0%	0.0%
Metal prod. surface coating	VOC limits	386	44	$1	$18,748	$2,271	0.0%	0.0%
Metal prod. surface coating	VOC limits	387	7	$1	$18,684	$2,833	0.0%	0.0%
Metal prod. surface coating	VOC limits	391	77	$1	$2,468	$1,090	0.0%	0.1%
Metal prod. surface coating	VOC limits	393	16	$1	$2,545	$1,225	0.0%	0.1%
Metal prod. surface coating	VOC limits	394	125	$1	$4,191	$1,938	0.0%	0.0%
Metal prod. surface coating	VOC limits	395	56	$1	$3,227	$1,294	0.0%	0.1%
Metal prod. surface coating	VOC limits	396	16	$1	$2,604	$1,126	0.0%	0.1%
Metal prod. surface coating	VOC limits	399	327	$1	$1,858	$1,009	0.1%	0.1%
Misc. surface coating	Add-on control	251	131	$1,129	$5,396	$1,773	20.9%	63.7%
Misc. surface coating	Add-on control	252	23	$1,129	$12,698	$2,271	8.9%	49.7%
Misc. surface coating	Add-on control	342	68	$1,129	$7,887	$2,003	14.3%	56.4%
Misc. surface coating	Add-on control	343	40	$1,129	$8,638	$2,429	13.1%	46.5%
Misc. surface coating	Add-on control	344	524	$1,129	$4,375	$2,469	25.8%	45.7%
Misc. surface coating	Add-on control	345	52	$1,129	$3,649	$2,234	31.0%	50.6%
Misc. surface coating	Add-on control	346	99	$1,129	$9,507	$2,730	11.9%	41.4%
Misc. surface coating	Add-on control	347	167	$1,129	$2,015	$1,371	56.0%	82.4%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Misc. surface coating	Add-on control	348	11	$1,129	$11,888	$1,003	9.5%	112.6%
Misc. surface coating	Add-on control	349	306	$1,129	$4,404	$1,989	25.6%	56.8%
Misc. surface coating	Add-on control	363	14	$1,129	$15,823	$1,850	7.1%	61.0%
Misc. surface coating	Add-on control	371	127	$1,129	$38,564	$2,267	2.9%	49.8%
Misc. surface coating	MACT control	351	8	$29	$17,804	$1,779	0.2%	1.7%
Misc. surface coating	MACT control	352	58	$29	$7,232	$1,480	0.4%	2.0%
Misc. surface coating	MACT control	353	70	$29	$6,416	$2,160	0.5%	1.4%
Misc. surface coating	MACT control	354	256	$29	$2,260	$1,154	1.3%	2.6%
Misc. surface coating	MACT control	355	174	$29	$3,761	$1,743	0.8%	1.7%
Misc. surface coating	MACT control	356	186	$29	$5,377	$2,069	0.6%	1.4%
Misc. surface coating	MACT control	357	78	$29	$15,064	$2,497	0.2%	1.2%
Misc. surface coating	MACT control	358	74	$29	$15,967	$2,683	0.2%	1.1%
Misc. surface coating	MACT control	359	635	$29	$1,171	$769	2.5%	3.8%
Misc. surface coating	MACT control	361	28	$29	$15,868	$2,716	0.2%	1.1%
Misc. surface coating	MACT control	362	65	$29	$10,107	$1,967	0.3%	1.5%
Misc. surface coating	MACT control	363	14	$29	$15,823	$1,850	0.2%	1.6%
Misc. surface coating	MACT control	364	85	$29	$13,071	$2,463	0.2%	1.2%
Misc. surface coating	MACT control	365	28	$29	$8,303	$1,766	0.4%	1.7%
Misc. surface coating	MACT control	366	88	$29	$12,188	$2,437	0.2%	1.2%
Misc. surface coating	MACT control	367	192	$29	$7,130	$1,627	0.4%	1.8%
Misc. surface coating	MACT control	369	79	$29	$12,090	$1,472	0.2%	2.0%
Misc. surface coating	MACT control	374	4	$29	$23,567	$5,656	0.1%	0.5%
Paper surface coating	Add-on control	267	113	$2,438	$17,201	$4,114	14.2%	59.3%
Pesticide Application	Reformulation - FIP rule	287	34	$320	$9,998	$3,481	3.2%	9.2%
Pharmaceutical mfg	RACT	283	17	$0	$22,363	$3,008	0.0%	0.0%
Service stations - stage I-truck	P-V valves	554	3783	$0	$1,458	$1,191	0.0%	0.0%
SOCMI fugitives	RACT	286	1	$2	$90,160	$13,860	0.0%	0.0%
Wood furniture surf coating	Reformulation	251	170	$20	$5,396	$1,773	0.4%	1.1%
Wood furniture surf coating	Reformulation	252	30	$20	$12,698	$2,271	0.2%	0.9%
Wood furniture surf coating	Reformulation	254	104	$20	$3,779	$1,958	0.5%	1.0%
Wood furniture surf coating	Reformulation	242	157	$1	$4,830	$2,310	0.0%	0.1%
Wood furniture surf coating	Reformulation	243	427	$1	$4,640	$1,918	0.0%	0.1%
Wood furniture surf coating	Reformulation	244	89	$1	$1,666	$1,298	0.1%	0.1%
Wood furniture surf coating	Reformulation	245	46	$1	$9,840	$3,971	0.0%	0.0%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Wood furniture surf coating	Reformulation	249	146	$1	$3,325	$1,862	0.0%	0.1%
Nonroad Vehicles								
Nonroad gasoline	Reform gas	291	1	$1,016	$553,301	$42,456	0.2%	2.4%
Recreational vehicles	CARB stds	375	5	$30	$7,336	$2,049	0.4%	1.5%
Recreational vehicles	CARB stds	379	20	$30	$9,164	$2,426	0.3%	1.3%
Onroad Vehicles								
Motor Vehicles	Cal. Reform	291	5	$47,901	$553,301	$42,456	8.7%	112.8%
Motor Vehicles	Fed. Reform	291	1	$10,593	$553,301	$42,456	1.9%	25.0%
Motor Vehicles	Reform Diesel	291	1	$25,282	$553,301	$42,456	4.6%	59.6%

TABLE D-5
8H1AX-80 NAAQS Alternative
Cost-to-Sales Ratios by Control Measure and SIC Code for All and Small Establishments
(in thousands of $1990)

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Stationary Point Sources								
Cement Mfg - Dry	SCR	324	2	$3,172	$27,047	$8,944	11.7%	35.5%
Gas Turbines - Nat. Gas	SCR + STEAM INJECTION	492	1	$401	$23,847	$13,894	1.7%	2.9%
Gas Turbines - Nat. Gas	SCR + STEAM INJECTION	509	1	$401	$5,706	$2,587	7.0%	15.5%
Gas Turbines - Oil	SCR + WATER INJECTION	491	1	$5,652	$33,269	$10,705	17.0%	52.8%
Glass Mfg - Container	Oxy-Firing	322	1	$4,775	$22,318	$1,275	21.4%	374.5%
IC Engines - Natural Gas	NSCR	492	2	$621	$23,847	$13,894	2.6%	4.5%
Indust. Boiler - Distillate Oil	SCR	201	1	$28	$19,290	$5,527	0.1%	0.5%
Indust. Boiler - Distillate Oil	SCR	221	1	$28	$25,356	$1,197	0.1%	2.3%
Indust. Boiler - Distillate Oil	SCR	252	1	$28	$12,698	$2,271	0.2%	1.2%
Indust. Boiler - Distillate Oil	SCR	262	1	$28	$145,607	$17,287	0.0%	0.2%
Indust. Boiler - Distillate Oil	SCR	267	1	$28	$17,201	$4,114	0.2%	0.7%
Indust. Boiler - Distillate Oil	SCR	275	1	$28	$2,058	$1,120	1.4%	2.5%
Indust. Boiler - Distillate Oil	SCR	281	1	$28	$22,955	$7,204	0.1%	0.4%
Indust. Boiler - Distillate Oil	SCR	282	2	$28	$111,791	$16,963	0.0%	0.2%
Indust. Boiler - Distillate Oil	SCR	322	1	$28	$22,318	$1,275	0.1%	2.2%
Indust. Boiler - Distillate Oil	SCR	329	2	$28	$8,551	$2,894	0.3%	1.0%
Indust. Boiler - Distillate Oil	SCR	331	1	$28	$49,452	$5,095	0.1%	0.6%
Indust. Boiler - Distillate Oil	SCR	348	1	$28	$11,888	$1,003	0.2%	2.8%
Indust. Boiler - Distillate Oil	SCR	373	1	$28	$9,088	$1,459	0.3%	1.9%
Indust. Boiler - Distillate Oil	SCR	822	1	$28	$8,662	$560	0.3%	5.0%
Indust. Boiler - Distillate Oil	SCR	971	1	$28	$475,435,160		0.0%	
Indust. Boiler - Nat. Gas	SCR	201	1	$98	$19,290	$5,527	0.5%	1.8%
Indust. Boiler - Nat. Gas	SCR	203	1	$98	$11,814	$3,495	0.8%	2.8%
Indust. Boiler - Nat. Gas	SCR	221	2	$98	$25,356	$1,197	0.4%	8.2%
Indust. Boiler - Nat. Gas	SCR	223	1	$98	$22,019	$2,238	0.5%	4.4%
Indust. Boiler - Nat. Gas	SCR	252	1	$98	$12,698	$2,271	0.8%	4.3%
Indust. Boiler - Nat. Gas	SCR	254	1	$98	$3,779	$1,958	2.6%	5.0%
Indust. Boiler - Nat. Gas	SCR	267	2	$98	$17,201	$4,114	0.6%	2.4%
Indust. Boiler - Nat. Gas	SCR	275	2	$98	$2,058	$1,120	4.8%	8.8%
Indust. Boiler - Nat. Gas	SCR	281	1	$98	$22,955	$7,204	0.4%	1.4%
Indust. Boiler - Nat. Gas	SCR	282	2	$98	$111,791	$16,963	0.1%	0.6%
Indust. Boiler - Nat. Gas	SCR	295	1	$98	$6,445	$4,657	1.5%	2.1%
Indust. Boiler - Nat. Gas	SCR	301	1	$98	$99,723	$3,747	0.1%	2.6%
Indust. Boiler - Nat. Gas	SCR	311	1	$98	$6,984	$3,001	1.4%	3.3%
Indust. Boiler - Nat. Gas	SCR	322	1	$98	$22,318	$1,275	0.4%	7.7%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Indust. Boiler - Nat. Gas	SCR	329	2	$98	$8,551	$2,894	1.2%	3.4%
Indust. Boiler - Nat. Gas	SCR	331	1	$98	$49,452	$5,095	0.2%	1.9%
Indust. Boiler - Nat. Gas	SCR	333	3	$98	$74,465	$4,050	0.1%	2.4%
Indust. Boiler - Nat. Gas	SCR	362	1	$98	$10,107	$1,967	1.0%	5.0%
Indust. Boiler - Nat. Gas	SCR	371	1	$98	$38,564	$2,267	0.3%	4.3%
Indust. Boiler - Nat. Gas	SCR	372	1	$98	$80,938	$2,963	0.1%	3.3%
Indust. Boiler - Nat. Gas	SCR	806	1	$98	$15,066	$4,150	0.7%	2.4%
Indust. Boiler - Nat. Gas	SCR	822	2	$98	$8,662	$560	1.1%	17.6%
Industrial Boiler - PC	SCR	261	1	$2,585	$153,545	$33,447	1.7%	7.7%
Industrial Boiler - PC	SCR	263	1	$2,585	$96,730	$21,071	2.7%	12.3%
Industrial Boiler - PC	SCR	282	1	$2,585	$111,791	$16,963	2.3%	15.2%
Industrial Boiler - PC	SCR	348	1	$2,585	$11,888	$1,003	21.7%	257.7%
Industrial Boiler - PC	SCR	371	1	$2,585	$38,564	$2,267	6.7%	114.0%
Industrial Boiler - PC	SCR	822	1	$2,585	$8,662	$560	29.8%	461.6%
Industrial Boiler - Resid. Oil	SCR	203	2	$128	$11,814	$3,495	1.1%	3.7%
Industrial Boiler - Resid. Oil	SCR	223	2	$128	$22,019	$2,238	0.6%	5.7%
Industrial Boiler - Resid. Oil	SCR	226	1	$128	$13,299	$2,913	1.0%	4.4%
Industrial Boiler - Resid. Oil	SCR	242	1	$128	$4,830	$2,310	2.6%	5.5%
Industrial Boiler - Resid. Oil	SCR	254	1	$128	$3,779	$1,958	3.4%	6.5%
Industrial Boiler - Resid. Oil	SCR	261	1	$128	$153,545	$33,447	0.1%	0.4%
Industrial Boiler - Resid. Oil	SCR	262	1	$128	$145,607	$17,287	0.1%	0.7%
Industrial Boiler - Resid. Oil	SCR	282	2	$128	$111,791	$16,963	0.1%	0.8%
Industrial Boiler - Resid. Oil	SCR	295	2	$128	$6,445	$4,657	2.0%	2.7%
Industrial Boiler - Resid. Oil	SCR	301	1	$128	$99,723	$3,747	0.1%	3.4%
Industrial Boiler - Resid. Oil	SCR	311	1	$128	$6,984	$3,001	1.8%	4.3%
Industrial Boiler - Resid. Oil	SCR	371	1	$128	$38,564	$2,267	0.3%	5.6%
Industrial Boiler - Resid. Oil	SCR	373	1	$128	$9,088	$1,459	1.4%	8.7%
Industrial Boiler - Resid. Oil	SCR	806	1	$128	$15,066	$4,150	0.9%	3.1%
Industrial Boiler - Resid. Oil	SCR	971	1	$128	$475,435,160		0.0%	
Industrial Boiler - Stoker	SCR	213	1	$174	$58,200	$6,053	0.3%	2.9%
Industrial Boiler - Stoker	SCR	221	1	$174	$25,356	$1,197	0.7%	14.5%
Industrial Boiler - Stoker	SCR	229	1	$174	$8,724	$2,628	2.0%	6.6%
Industrial Boiler - Stoker	SCR	333	2	$174	$74,465	$4,050	0.2%	4.3%
Industrial Boiler - Stoker	SCR	371	1	$174	$38,564	$2,267	0.5%	7.7%
Industrial Boiler - Stoker	SCR	806	1	$174	$15,066	$4,150	1.2%	4.2%
Industrial Boiler - Stoker	SCR	822	2	$174	$8,662	$560	2.0%	31.0%
Municipal Waste Combus	SNCR	495	1	$439	$4,108	$2,936	10.7%	15.0%
Point Source Ind. Surface Coating	Add-on Control Levels	11	1	$4,494	$90	$81	4993.3%	5548.1%
Point Source Ind. Surface Coating	Add-on Control Levels	203	1	$4,494	$11,814	$3,495	38.0%	128.6%
Point Source Ind. Surface Coating	Add-on Control Levels	243	1	$4,494	$4,640	$1,918	96.9%	234.3%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Point Source Ind. Surface Coating	Add-on Control Levels	251	3	$4,494	$5,396	$1,773	83.3%	253.5%
Point Source Ind. Surface Coating	Add-on Control Levels	252	1	$4,494	$12,698	$2,271	35.4%	197.9%
Point Source Ind. Surface Coating	Add-on Control Levels	291	1	$4,494	$553,301	$42,456	0.8%	10.6%
Point Source Ind. Surface Coating	Add-on Control Levels	295	1	$4,494	$6,445	$4,657	69.7%	96.5%
Point Source Ind. Surface Coating	Add-on Control Levels	308	2	$4,494	$5,716	$2,556	78.6%	175.8%
Point Source Ind. Surface Coating	Add-on Control Levels	331	2	$4,494	$49,452	$5,095	9.1%	88.2%
Point Source Ind. Surface Coating	Add-on Control Levels	332	1	$4,494	$8,205	$1,747	54.8%	257.2%
Point Source Ind. Surface Coating	Add-on Control Levels	339	1	$4,494	$3,490	$2,182	128.8%	206.0%
Point Source Ind. Surface Coating	Add-on Control Levels	340	4	$4,494	$4,479	$1,862	100.3%	241.4%
Point Source Ind. Surface Coating	Add-on Control Levels	341	2	$4,494	$30,750	$10,316	14.6%	43.6%
Point Source Ind. Surface Coating	Add-on Control Levels	342	2	$4,494	$7,887	$2,003	57.0%	224.4%
Point Source Ind. Surface Coating	Add-on Control Levels	344	4	$4,494	$4,375	$2,469	102.7%	182.0%
Point Source Ind. Surface Coating	Add-on Control Levels	346	3	$4,494	$9,507	$2,730	47.3%	164.6%
Point Source Ind. Surface Coating	Add-on Control Levels	347	1	$4,494	$2,015	$1,371	223.0%	327.8%
Point Source Ind. Surface Coating	Add-on Control Levels	348	1	$4,494	$11,888	$1,003	37.8%	448.1%
Point Source Ind. Surface Coating	Add-on Control Levels	349	3	$4,494	$4,404	$1,989	102.0%	225.9%
Point Source Ind. Surface Coating	Add-on Control Levels	353	3	$4,494	$6,416	$2,160	70.0%	208.1%
Point Source Ind. Surface Coating	Add-on Control Levels	358	2	$4,494	$15,967	$2,683	28.2%	167.5%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Point Source Ind. Surface Coating	Add-on Control Levels	362	2	$4,494	$10,107	$1,967	44.5%	228.5%
Point Source Ind. Surface Coating	Add-on Control Levels	363	2	$4,494	$15,823	$1,850	28.4%	242.9%
Point Source Ind. Surface Coating	Add-on Control Levels	364	1	$4,494	$13,071	$2,463	34.4%	182.5%
Point Source Ind. Surface Coating	Add-on Control Levels	366	1	$4,494	$12,188	$2,437	36.9%	184.4%
Point Source Ind. Surface Coating	Add-on Control Levels	367	2	$4,494	$7,130	$1,627	63.0%	276.2%
Point Source Ind. Surface Coating	Add-on Control Levels	370	2	$4,494	$35,538	$2,260	12.7%	198.9%
Point Source Ind. Surface Coating	Add-on Control Levels	371	27	$4,494	$38,564	$2,267	11.7%	198.2%
Point Source Ind. Surface Coating	Add-on Control Levels	372	3	$4,494	$80,938	$2,963	5.6%	151.7%
Point Source Ind. Surface Coating	Add-on Control Levels	373	2	$4,494	$9,088	$1,459	49.5%	308.0%
Point Source Ind. Surface Coating	Add-on Control Levels	376	1	$4,494	$316,586	$5,142	1.4%	87.4%
Point Source Ind. Surface Coating	Add-on Control Levels	399	1	$4,494	$1,858	$1,009	241.9%	445.4%
Point Source Ind. Surface Coating	Add-on Control Levels	458	1	$4,494	$2,755	$1,430	163.1%	314.3%
Point Source Ind. Surface Coating	Add-on Control Levels	971	4	$4,494	$475,435,160		0.0%	
Point Source Wood Product Coating	FIP VOC Limits	242	1	$2	$4,830	$2,310	0.0%	0.1%
Point Source Wood Product Coating	FIP VOC Limits	243	3	$2	$4,640	$1,918	0.1%	0.1%
Point Source Wood Product Coating	FIP VOC Limits	249	1	$2	$3,325	$1,862	0.1%	0.1%
Point Source Wood Product Coating	FIP VOC Limits	251	2	$2	$5,396	$1,773	0.0%	0.1%
Point Source Wood Product Coating	FIP VOC Limits	341	1	$2	$30,750	$10,316	0.0%	0.0%
Point Source Wood Product Coating	FIP VOC Limits	349	1	$2	$4,404	$1,989	0.1%	0.1%
Point Source Wood Product Coating	FIP VOC Limits	371	1	$2	$38,564	$2,267	0.0%	0.1%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Point Sources	RE	131	4	$2,043	$7,430	$3,265	27.5%	62.6%
Point Sources	RE	204	1	$2,043	$9,583	$3,428	21.3%	59.6%
Point Sources	RE	207	2	$2,043	$43,948	$21,299	4.7%	9.6%
Point Sources	RE	226	1	$2,043	$13,299	$2,913	15.4%	70.2%
Point Sources	RE	260	1	$2,043	$16,187	$3,526	12.6%	58.0%
Point Sources	RE	262	1	$2,043	$145,607	$17,287	1.4%	11.8%
Point Sources	RE	263	2	$2,043	$96,730	$21,071	2.1%	9.7%
Point Sources	RE	265	5	$2,043	$13,215	$5,965	15.5%	34.3%
Point Sources	RE	267	8	$2,043	$17,201	$4,114	11.9%	49.7%
Point Sources	RE	272	1	$2,043	$7,692	$2,324	26.6%	87.9%
Point Sources	RE	275	13	$2,043	$2,058	$1,120	99.3%	182.4%
Point Sources	RE	281	3	$2,043	$22,955	$7,204	8.9%	28.4%
Point Sources	RE	282	14	$2,043	$111,791	$16,963	1.8%	12.1%
Point Sources	RE	283	4	$2,043	$22,363	$3,008	9.1%	67.9%
Point Sources	RE	286	23	$2,043	$90,160	$13,860	2.3%	14.7%
Point Sources	RE	287	3	$2,043	$9,998	$3,481	20.4%	58.7%
Point Sources	RE	291	22	$2,043	$553,301	$42,456	0.4%	4.8%
Point Sources	RE	295	4	$2,043	$6,445	$4,657	31.7%	43.9%
Point Sources	RE	299	2	$2,043	$9,142	$6,903	22.4%	29.6%
Point Sources	RE	306	1	$2,043	$9,416	$3,076	21.7%	66.4%
Point Sources	RE	308	6	$2,043	$5,716	$2,556	35.8%	79.9%
Point Sources	RE	329	3	$2,043	$8,551	$2,894	23.9%	70.6%
Point Sources	RE	331	9	$2,043	$49,452	$5,095	4.1%	40.1%
Point Sources	RE	341	7	$2,043	$30,750	$10,316	6.7%	19.8%
Point Sources	RE	342	1	$2,043	$7,887	$2,003	25.9%	102.0%
Point Sources	RE	346	2	$2,043	$9,507	$2,730	21.5%	74.9%
Point Sources	RE	347	2	$2,043	$2,015	$1,371	101.4%	149.0%
Point Sources	RE	349	2	$2,043	$4,404	$1,989	46.4%	102.7%
Point Sources	RE	363	1	$2,043	$15,823	$1,850	12.9%	110.5%
Point Sources	RE	371	1	$2,043	$38,564	$2,267	5.3%	90.1%
Point Sources	RE	372	1	$2,043	$80,938	$2,963	2.5%	69.0%
Point Sources	RE	399	1	$2,043	$1,858	$1,009	110.0%	202.5%
Point Sources	RE	461	2	$2,043	$8,585	$6,546	23.8%	31.2%
Point Sources	RE	491	1	$2,043	$33,269	$10,705	6.1%	19.1%
Point Sources	RE	493	1	$2,043	$48,314	$9,973	4.2%	20.5%
Point Sources	RE	495	1	$2,043	$4,108	$2,936	49.7%	69.6%
Point Sources	RE	509	1	$2,043	$5,706	$2,587	35.8%	79.0%
Point Sources	RE	516	1	$2,043	$3,917	$3,412	52.2%	59.9%
Point Sources	RE	517	32	$2,043	$9,839	$8,410	20.8%	24.3%
Point Sources	RE	721	1	$2,043	$408	$278	501.4%	734.8%
Point Sources	RE	971	3	$2,043	$475,435,160		0.0%	
Process Heaters - Dist. Oil	LNB + SCR	822	1	$2	$8,662	$560	0.0%	0.3%
Process Heaters - Nat. Gas	LNB + SCR	333	1	$104	$74,465	$4,050	0.1%	2.6%
Process Heaters - Nat. Gas	LNB + SCR	362	1	$104	$10,107	$1,967	1.0%	5.3%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Process Heaters - Nat. Gas	LNB + SCR	363	1	$104	$15,823	$1,850	0.7%	5.6%
Process Heaters - Nat. Gas	LNB + SCR	371	1	$104	$38,564	$2,267	0.3%	4.6%
Process Heaters - Nat. Gas	LNB + SCR	822	1	$104	$8,662	$560	1.2%	18.5%
Util. Boiler - Oil-Gas/Tang.	SCR	491	2	$2,819	$33,269	$10,705	8.5%	26.3%
Stationary Area Sources								
Adhesives - industrial	RACT	289	498	$8	$8,863	$5,318	0.1%	0.1%
Aerosols	CARB Tier 2 Standards - Reform	285	70	$18	$13,724	$6,287	0.1%	0.3%
Aerosols	SCAQMD Standards - Reformulati	285	70	$1,088	$13,724	$6,287	7.9%	17.3%
Aircraft surface coating	Add-on control	372	261	$1,531	$80,938	$2,963	1.9%	51.7%
Area Source Ind. Coal Comb	RACT (small)	144	15	$13	$1,509	$1,331	0.9%	1.0%
Area Source Ind. Coal Comb	RACT (small)	201	30	$13	$19,290	$5,527	0.1%	0.2%
Area Source Ind. Coal Comb	RACT (small)	202	14	$13	$13,315	$5,007	0.1%	0.3%
Area Source Ind. Coal Comb	RACT (small)	203	13	$13	$11,814	$3,495	0.1%	0.4%
Area Source Ind. Coal Comb	RACT (small)	204	19	$13	$9,583	$3,428	0.1%	0.4%
Area Source Ind. Coal Comb	RACT (small)	206	4	$13	$7,010	$2,669	0.2%	0.5%
Area Source Ind. Coal Comb	RACT (small)	207	2	$13	$43,948	$21,299	0.0%	0.1%
Area Source Ind. Coal Comb	RACT (small)	208	9	$13	$14,053	$3,686	0.1%	0.4%
Area Source Ind. Coal Comb	RACT (small)	225	10	$13	$5,310	$1,968	0.2%	0.7%
Area Source Ind. Coal Comb	RACT (small)	226	6	$13	$13,299	$2,913	0.1%	0.4%
Area Source Ind. Coal Comb	RACT (small)	229	10	$13	$8,724	$2,628	0.2%	0.5%
Area Source Ind. Coal Comb	RACT (small)	243	72	$13	$4,640	$1,918	0.3%	0.7%
Area Source Ind. Coal Comb	RACT (small)	251	53	$13	$5,396	$1,773	0.2%	0.7%
Area Source Ind. Coal Comb	RACT (small)	262	2	$13	$145,607	$17,287	0.0%	0.1%
Area Source Ind. Coal Comb	RACT (small)	267	19	$13	$17,201	$4,114	0.1%	0.3%
Area Source Ind. Coal Comb	RACT (small)	281	13	$13	$22,955	$7,204	0.1%	0.2%
Area Source Ind. Coal Comb	RACT (small)	282	3	$13	$111,791	$16,963	0.0%	0.1%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Area Source Ind. Coal Comb	RACT (small)	283	15	$13	$22,363	$3,008	0.1%	0.4%
Area Source Ind. Coal Comb	RACT (small)	284	9	$13	$12,882	$2,980	0.1%	0.4%
Area Source Ind. Coal Comb	RACT (small)	286	1	$13	$90,160	$13,860	0.0%	0.1%
Area Source Ind. Coal Comb	RACT (small)	287	6	$13	$9,998	$3,481	0.1%	0.4%
Area Source Ind. Coal Comb	RACT (small)	289	23	$13	$8,863	$5,318	0.1%	0.2%
Area Source Ind. Coal Comb	RACT (small)	301	4	$13	$99,723	$3,747	0.0%	0.3%
Area Source Ind. Coal Comb	RACT (small)	306	11	$13	$9,416	$3,076	0.1%	0.4%
Area Source Ind. Coal Comb	RACT (small)	308	98	$13	$5,716	$2,556	0.2%	0.5%
Area Source Ind. Coal Comb	RACT (small)	311	4	$13	$6,984	$3,001	0.2%	0.4%
Area Source Ind. Coal Comb	RACT (small)	324	1	$13	$27,047	$8,944	0.1%	0.1%
Area Source Ind. Coal Comb	RACT (small)	326	20	$13	$3,426	$859	0.4%	1.5%
Area Source Ind. Coal Comb	RACT (small)	327	76	$13	$3,400	$2,338	0.4%	0.6%
Area Source Ind. Coal Comb	RACT (small)	331	9	$13	$49,452	$5,095	0.0%	0.3%
Area Source Ind. Coal Comb	RACT (small)	334	6	$13	$13,040	$8,343	0.1%	0.2%
Area Source Ind. Coal Comb	RACT (small)	346	25	$13	$9,507	$2,730	0.1%	0.5%
Area Source Ind. Coal Comb	RACT (small)	351	1	$13	$17,804	$1,779	0.1%	0.7%
Area Source Ind. Coal Comb	RACT (small)	353	20	$13	$6,416	$2,160	0.2%	0.6%
Area Source Ind. Coal Comb	RACT (small)	354	81	$13	$2,260	$1,154	0.6%	1.1%
Area Source Ind. Coal Comb	RACT (small)	362	16	$13	$10,107	$1,967	0.1%	0.7%
Area Source Ind. Coal Comb	RACT (small)	363	9	$13	$15,823	$1,850	0.1%	0.7%
Area Source Ind. Coal Comb	RACT (small)	371	49	$13	$38,564	$2,267	0.0%	0.6%
Area Source Ind. Coal Comb	RACT (small)	374	3	$13	$23,567	$5,656	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	131	3	$9	$7,430	$3,265	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	147	2	$9	$9,468	$610	0.1%	1.5%
Area Source Ind. NG Comb	RACT (small)	201	38	$9	$19,290	$5,527	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	202	19	$9	$13,315	$5,007	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	203	16	$9	$11,814	$3,495	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	204	17	$9	$9,583	$3,428	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	205	42	$9	$6,172	$1,208	0.2%	0.8%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Area Source Ind. NG Comb	RACT (small)	206	6	$9	$7,010	$2,669	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	207	6	$9	$43,948	$21,299	0.0%	0.0%
Area Source Ind. NG Comb	RACT (small)	208	21	$9	$14,053	$3,686	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	209	51	$9	$10,134	$3,348	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	222	6	$9	$17,327	$2,548	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	223	5	$9	$22,019	$2,238	0.0%	0.4%
Area Source Ind. NG Comb	RACT (small)	226	12	$9	$13,299	$2,913	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	229	17	$9	$8,724	$2,628	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	249	42	$9	$3,325	$1,862	0.3%	0.5%
Area Source Ind. NG Comb	RACT (small)	262	3	$9	$145,607	$17,287	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	263	3	$9	$96,730	$21,071	0.0%	0.0%
Area Source Ind. NG Comb	RACT (small)	265	63	$9	$13,215	$5,965	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	267	56	$9	$17,201	$4,114	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	275	594	$9	$2,058	$1,120	0.4%	0.8%
Area Source Ind. NG Comb	RACT (small)	280	256	$9	$21,178	$4,833	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	281	27	$9	$22,955	$7,204	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	282	7	$9	$111,791	$16,963	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	283	21	$9	$22,363	$3,008	0.0%	0.3%
Area Source Ind. NG Comb	RACT (small)	284	63	$9	$12,882	$2,980	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	285	34	$9	$13,724	$6,287	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	286	11	$9	$90,160	$13,860	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	287	6	$9	$9,998	$3,481	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	289	67	$9	$8,863	$5,318	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	291	3	$9	$553,301	$42,456	0.0%	0.0%
Area Source Ind. NG Comb	RACT (small)	295	32	$9	$6,445	$4,657	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	299	4	$9	$9,142	$6,903	0.1%	0.1%
Area Source Ind. NG Comb	RACT (small)	301	3	$9	$99,723	$3,747	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	306	15	$9	$9,416	$3,076	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	308	172	$9	$5,716	$2,556	0.2%	0.4%
Area Source Ind. NG Comb	RACT (small)	322	2	$9	$22,318	$1,275	0.0%	0.7%
Area Source Ind. NG Comb	RACT (small)	323	20	$9	$5,523	$1,746	0.2%	0.5%
Area Source Ind. NG Comb	RACT (small)	325	7	$9	$6,826	$3,735	0.1%	0.2%
Area Source Ind. NG Comb	RACT (small)	326	12	$9	$3,426	$859	0.3%	1.1%
Area Source Ind. NG Comb	RACT (small)	327	148	$9	$3,400	$2,338	0.3%	0.4%
Area Source Ind. NG Comb	RACT (small)	329	22	$9	$8,551	$2,894	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	331	13	$9	$49,452	$5,095	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	332	6	$9	$8,205	$1,747	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	333	1	$9	$74,465	$4,050	0.0%	0.2%
Area Source Ind. NG Comb	RACT (small)	334	6	$9	$13,040	$8,343	0.1%	0.1%
Area Source Ind. NG Comb	RACT (small)	335	19	$9	$36,514	$6,961	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	339	5	$9	$3,490	$2,182	0.3%	0.4%
Area Source Ind. NG Comb	RACT (small)	341	9	$9	$30,750	$10,316	0.0%	0.1%
Area Source Ind. NG Comb	RACT (small)	344	175	$9	$4,375	$2,469	0.2%	0.4%
Area Source Ind. NG Comb	RACT (small)	346	31	$9	$9,507	$2,730	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	348	5	$9	$11,888	$1,003	0.1%	0.9%
Area Source Ind. NG Comb	RACT (small)	349	102	$9	$4,404	$1,989	0.2%	0.5%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Area Source Ind. NG Comb	RACT (small)	352	15	$9	$7,232	$1,480	0.1%	0.6%
Area Source Ind. NG Comb	RACT (small)	353	33	$9	$6,416	$2,160	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	357	40	$9	$15,064	$2,497	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	358	26	$9	$15,967	$2,683	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	361	15	$9	$15,868	$2,716	0.1%	0.3%
Area Source Ind. NG Comb	RACT (small)	362	15	$9	$10,107	$1,967	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	363	3	$9	$15,823	$1,850	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	364	17	$9	$13,071	$2,463	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	365	9	$9	$8,303	$1,766	0.1%	0.5%
Area Source Ind. NG Comb	RACT (small)	367	67	$9	$7,130	$1,627	0.1%	0.6%
Area Source Ind. NG Comb	RACT (small)	371	61	$9	$38,564	$2,267	0.0%	0.4%
Area Source Ind. NG Comb	RACT (small)	372	14	$9	$80,938	$2,963	0.0%	0.3%
Area Source Ind. NG Comb	RACT (small)	386	12	$9	$18,748	$2,271	0.1%	0.4%
Area Source Ind. NG Comb	RACT (small)	391	6	$9	$2,468	$1,090	0.4%	0.8%
Area Source Ind. NG Comb	RACT (small)	399	89	$9	$1,858	$1,009	0.5%	0.9%
Area Source Ind. Oil Comb	RACT (small)	201	30	$17	$19,290	$5,527	0.1%	0.3%
Area Source Ind. Oil Comb	RACT (small)	203	13	$17	$11,814	$3,495	0.1%	0.5%
Area Source Ind. Oil Comb	RACT (small)	204	19	$17	$9,583	$3,428	0.2%	0.5%
Area Source Ind. Oil Comb	RACT (small)	205	30	$17	$6,172	$1,208	0.3%	1.4%
Area Source Ind. Oil Comb	RACT (small)	206	4	$17	$7,010	$2,669	0.2%	0.6%
Area Source Ind. Oil Comb	RACT (small)	207	2	$17	$43,948	$21,299	0.0%	0.1%
Area Source Ind. Oil Comb	RACT (small)	208	9	$17	$14,053	$3,686	0.1%	0.5%
Area Source Ind. Oil Comb	RACT (small)	209	29	$17	$10,134	$3,348	0.2%	0.5%
Area Source Ind. Oil Comb	RACT (small)	221	5	$17	$25,356	$1,197	0.1%	1.4%
Area Source Ind. Oil Comb	RACT (small)	223	1	$17	$22,019	$2,238	0.1%	0.7%
Area Source Ind. Oil Comb	RACT (small)	224	4	$17	$6,649	$2,231	0.3%	0.7%
Area Source Ind. Oil Comb	RACT (small)	226	6	$17	$13,299	$2,913	0.1%	0.6%
Area Source Ind. Oil Comb	RACT (small)	229	10	$17	$8,724	$2,628	0.2%	0.6%
Area Source Ind. Oil Comb	RACT (small)	233	15	$17	$4,358	$1,950	0.4%	0.9%
Area Source Ind. Oil Comb	RACT (small)	249	28	$17	$3,325	$1,862	0.5%	0.9%
Area Source Ind. Oil Comb	RACT (small)	251	53	$17	$5,396	$1,773	0.3%	0.9%
Area Source Ind. Oil Comb	RACT (small)	262	2	$17	$145,607	$17,287	0.0%	0.1%
Area Source Ind. Oil Comb	RACT (small)	265	22	$17	$13,215	$5,965	0.1%	0.3%
Area Source Ind. Oil Comb	RACT (small)	267	19	$17	$17,201	$4,114	0.1%	0.4%
Area Source Ind. Oil Comb	RACT (small)	271	72	$17	$6,017	$1,303	0.3%	1.3%
Area Source Ind. Oil Comb	RACT (small)	275	316	$17	$2,058	$1,120	0.8%	1.5%
Area Source Ind. Oil Comb	RACT (small)	281	13	$17	$22,955	$7,204	0.1%	0.2%
Area Source Ind. Oil Comb	RACT (small)	282	3	$17	$111,791	$16,963	0.0%	0.1%
Area Source Ind. Oil Comb	RACT (small)	283	15	$17	$22,363	$3,008	0.1%	0.6%
Area Source Ind. Oil Comb	RACT (small)	284	9	$17	$12,882	$2,980	0.1%	0.6%
Area Source Ind. Oil Comb	RACT (small)	286	1	$17	$90,160	$13,860	0.0%	0.1%
Area Source Ind. Oil Comb	RACT (small)	287	6	$17	$9,998	$3,481	0.2%	0.5%
Area Source Ind. Oil Comb	RACT (small)	289	23	$17	$8,863	$5,318	0.2%	0.3%
Area Source Ind. Oil Comb	RACT (small)	295	14	$17	$6,445	$4,657	0.3%	0.4%
Area Source Ind. Oil Comb	RACT (small)	301	4	$17	$99,723	$3,747	0.0%	0.4%
Area Source Ind. Oil Comb	RACT (small)	305	2	$17	$10,588	$3,246	0.2%	0.5%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Area Source Ind. Oil Comb	RACT (small)	306	11	$17	$9,416	$3,076	0.2%	0.5%
Area Source Ind. Oil Comb	RACT (small)	308	98	$17	$5,716	$2,556	0.3%	0.7%
Area Source Ind. Oil Comb	RACT (small)	311	4	$17	$6,984	$3,001	0.2%	0.6%
Area Source Ind. Oil Comb	RACT (small)	329	8	$17	$8,551	$2,894	0.2%	0.6%
Area Source Ind. Oil Comb	RACT (small)	331	9	$17	$49,452	$5,095	0.0%	0.3%
Area Source Ind. Oil Comb	RACT (small)	334	6	$17	$13,040	$8,343	0.1%	0.2%
Area Source Ind. Oil Comb	RACT (small)	335	6	$17	$36,514	$6,961	0.1%	0.2%
Area Source Ind. Oil Comb	RACT (small)	339	11	$17	$3,490	$2,182	0.5%	0.8%
Area Source Ind. Oil Comb	RACT (small)	342	13	$17	$7,887	$2,003	0.2%	0.8%
Area Source Ind. Oil Comb	RACT (small)	343	6	$17	$8,638	$2,429	0.2%	0.7%
Area Source Ind. Oil Comb	RACT (small)	344	118	$17	$4,375	$2,469	0.4%	0.7%
Area Source Ind. Oil Comb	RACT (small)	348	9	$17	$11,888	$1,003	0.1%	1.7%
Area Source Ind. Oil Comb	RACT (small)	351	1	$17	$17,804	$1,779	0.1%	0.9%
Area Source Ind. Oil Comb	RACT (small)	353	20	$17	$6,416	$2,160	0.3%	0.8%
Area Source Ind. Oil Comb	RACT (small)	356	18	$17	$5,377	$2,069	0.3%	0.8%
Area Source Ind. Oil Comb	RACT (small)	357	11	$17	$15,064	$2,497	0.1%	0.7%
Area Source Ind. Oil Comb	RACT (small)	358	15	$17	$15,967	$2,683	0.1%	0.6%
Area Source Ind. Oil Comb	RACT (small)	359	146	$17	$1,171	$769	1.4%	2.2%
Area Source Ind. Oil Comb	RACT (small)	361	2	$17	$15,868	$2,716	0.1%	0.6%
Area Source Ind. Oil Comb	RACT (small)	362	16	$17	$10,107	$1,967	0.2%	0.8%
Area Source Ind. Oil Comb	RACT (small)	366	13	$17	$12,188	$2,437	0.1%	0.7%
Area Source Ind. Oil Comb	RACT (small)	367	33	$17	$7,130	$1,627	0.2%	1.0%
Area Source Ind. Oil Comb	RACT (small)	369	17	$17	$12,090	$1,472	0.1%	1.1%
Area Source Ind. Oil Comb	RACT (small)	371	49	$17	$38,564	$2,267	0.0%	0.7%
Area Source Ind. Oil Comb	RACT (small)	372	8	$17	$80,938	$2,963	0.0%	0.6%
Area Source Ind. Oil Comb	RACT (small)	373	57	$17	$9,088	$1,459	0.2%	1.1%
Area Source Ind. Oil Comb	RACT (small)	376	1	$17	$316,586	$5,142	0.0%	0.3%
Area Source Ind. Oil Comb	RACT (small)	384	30	$17	$10,100	$2,241	0.2%	0.7%
Area Source Ind. Oil Comb	RACT (small)	386	2	$17	$18,748	$2,271	0.1%	0.7%
Area Source Ind. Oil Comb	RACT (small)	391	7	$17	$2,468	$1,090	0.7%	1.5%
Area Source Ind. Oil Comb	RACT (small)	393	6	$17	$2,545	$1,225	0.7%	1.4%
Automobile refinishing	CARB BARCT limits	753	2785	$1	$473	$454	0.1%	0.1%
Automobile refinishing	FIP Rule (VOC Content & TE)	753	17177	$13	$473	$454	2.7%	2.8%
Bulk Terminals	RACT	517	1204	$3	$9,839	$8,410	0.0%	0.0%
Marine Surface Coating	Add-on control	373	265	$693	$9,088	$1,459	7.6%	47.5%
Metal prod. surface coating	VOC limits	341	124	$1	$30,750	$10,316	0.0%	0.0%
Metal prod. surface coating	VOC limits	349	1919	$1	$4,404	$1,989	0.0%	0.1%
Metal prod. surface coating	VOC limits	371	734	$1	$38,564	$2,267	0.0%	0.1%
Metal prod. surface coating	VOC limits	375	34	$1	$7,336	$2,049	0.0%	0.1%
Metal prod. surface coating	VOC limits	376	31	$1	$316,586	$5,142	0.0%	0.0%
Metal prod. surface coating	VOC limits	381	197	$1	$50,989	$2,025	0.0%	0.1%
Metal prod. surface coating	VOC limits	382	860	$1	$9,496	$2,342	0.0%	0.0%
Metal prod. surface coating	VOC limits	384	745	$1	$10,100	$2,241	0.0%	0.1%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Metal prod. surface coating	VOC limits	385	104	$1	$12,731	$2,587	0.0%	0.0%
Metal prod. surface coating	VOC limits	386	205	$1	$18,748	$2,271	0.0%	0.1%
Metal prod. surface coating	VOC limits	387	33	$1	$18,684	$2,833	0.0%	0.0%
Metal prod. surface coating	VOC limits	391	654	$1	$2,468	$1,090	0.0%	0.1%
Metal prod. surface coating	VOC limits	393	90	$1	$2,545	$1,225	0.0%	0.1%
Metal prod. surface coating	VOC limits	394	525	$1	$4,191	$1,938	0.0%	0.1%
Metal prod. surface coating	VOC limits	395	219	$1	$3,227	$1,294	0.0%	0.1%
Metal prod. surface coating	VOC limits	396	413	$1	$2,604	$1,126	0.0%	0.1%
Metal prod. surface coating	VOC limits	399	1611	$1	$1,858	$1,009	0.1%	0.1%
Misc. surface coating	Add-on control	251	523	$934	$5,396	$1,773	17.3%	52.7%
Misc. surface coating	Add-on control	252	150	$934	$12,698	$2,271	7.4%	41.1%
Misc. surface coating	Add-on control	342	445	$934	$7,887	$2,003	11.8%	46.6%
Misc. surface coating	Add-on control	343	149	$934	$8,638	$2,429	10.8%	38.4%
Misc. surface coating	Add-on control	344	2012	$934	$4,375	$2,469	21.3%	37.8%
Misc. surface coating	Add-on control	345	556	$934	$3,649	$2,234	25.6%	41.8%
Misc. surface coating	Add-on control	346	841	$934	$9,507	$2,730	9.8%	34.2%
Misc. surface coating	Add-on control	347	1139	$934	$2,015	$1,371	46.3%	68.1%
Misc. surface coating	Add-on control	348	51	$934	$11,888	$1,003	7.9%	93.1%
Misc. surface coating	Add-on control	349	1598	$934	$4,404	$1,989	21.2%	46.9%
Misc. surface coating	Add-on control	363	80	$934	$15,823	$1,850	5.9%	50.5%
Misc. surface coating	Add-on control	371	591	$934	$38,564	$2,267	2.4%	41.2%
Misc. surface coating	MACT control	351	34	$29	$17,804	$1,779	0.2%	1.7%
Misc. surface coating	MACT control	352	137	$29	$7,232	$1,480	0.4%	2.0%
Misc. surface coating	MACT control	353	473	$29	$6,416	$2,160	0.5%	1.4%
Misc. surface coating	MACT control	354	1795	$29	$2,260	$1,154	1.3%	2.6%
Misc. surface coating	MACT control	355	818	$29	$3,761	$1,743	0.8%	1.7%
Misc. surface coating	MACT control	356	698	$29	$5,377	$2,069	0.6%	1.4%
Misc. surface coating	MACT control	357	390	$29	$15,064	$2,497	0.2%	1.2%
Misc. surface coating	MACT control	358	401	$29	$15,967	$2,683	0.2%	1.1%
Misc. surface coating	MACT control	359	3338	$29	$1,171	$769	2.5%	3.8%
Misc. surface coating	MACT control	361	137	$29	$15,868	$2,716	0.2%	1.1%
Misc. surface coating	MACT control	362	369	$29	$10,107	$1,967	0.3%	1.5%
Misc. surface coating	MACT control	363	77	$29	$15,823	$1,850	0.2%	1.6%
Misc. surface coating	MACT control	364	345	$29	$13,071	$2,463	0.2%	1.2%
Misc. surface coating	MACT control	365	132	$29	$8,303	$1,766	0.4%	1.7%
Misc. surface coating	MACT control	366	386	$29	$12,188	$2,437	0.2%	1.2%
Misc. surface coating	MACT control	367	1102	$29	$7,130	$1,627	0.4%	1.8%

Source Category	Control Measure	SIC Code	Number of Total Establish-ments Affected	Average Cost per Establish-ment	Average Annual Sales per Establish-ment (All)	Average Annual Sales per Establish-ment (Small)	Cost-to-Sales Ratio (All)	Cost-to-Sales Ratio (Small)
Misc. surface coating	MACT control	369	353	$29	$12,090	$1,472	0.2%	2.0%
Misc. surface coating	MACT control	374	48	$29	$23,567	$5,656	0.1%	0.5%
Oil and natural gas production fields	RACT (equipment / maintenance)	131	1077	$0	$7,430	$3,265	0.0%	0.0%
Oil and natural gas production fields	RACT (equipment / maintenance)	132	37	$0	$34,275	$33,078	0.0%	0.0%
Oil and natural gas production fields	RACT (equipment / maintenance)	138	997	$0	$820	$501	0.0%	0.0%
Paper surface coating	Add-on control	267	497	$2,319	$17,201	$4,114	13.5%	56.4%
Pesticide Application	Reformulation - FIP rule	287	99	$281	$9,998	$3,481	2.8%	8.1%
Pharmaceutical mfg.	RACT	283	42	$1	$22,363	$3,008	0.0%	0.0%
Serv. stns - stage I-truck	P-V valves	554	17324	$0	$1,458	$1,191	0.0%	0.0%
SOCMI batch reactors	New CTG	286	9	$48	$90,160	$13,860	0.1%	0.4%
SOCMI fugitives	RACT	286	10	$1	$90,160	$13,860	0.0%	0.0%
Wood furniture surf coating	Reformulation	251	704	$16	$5,396	$1,773	0.3%	0.9%
Wood furniture surf coating	Reformulation	252	200	$16	$12,698	$2,271	0.1%	0.7%
Wood furniture surf coating	Reformulation	254	527	$16	$3,779	$1,958	0.4%	0.8%
Wood product surf coating	Reformulation	242	561	$1	$4,830	$2,310	0.0%	0.1%
Wood product surf coating	Reformulation	243	1500	$1	$4,640	$1,918	0.0%	0.1%
Wood product surf coating	Reformulation	244	288	$1	$1,666	$1,298	0.1%	0.1%
Wood product surf coating	Reformulation	245	152	$1	$9,840	$3,971	0.0%	0.0%
Wood product surf coating	Reformulation	249	550	$1	$3,325	$1,862	0.0%	0.1%
Nonroad Vehicles								
Comm. Marine Vessels	Emission Fees	444	2	$757	$11,446	$5,081	6.6%	14.9%
Nonroad Diesels	CARB Stds for > 175 HP	351	1	$4,104	$17,804	$1,779	23.1%	230.7%
Nonroad gasoline	Ref. gasoline	291	1	$1,626	$553,301	$42,456	0.3%	3.8%
Recreational vehicles	CARB stds	375	17	$51	$7,336	$2,049	0.7%	2.5%
Recreational vehicles	CARB stds	379	74	$51	$9,164	$2,426	0.6%	2.1%
Onroad Vehicles								
Motor Vehicles	California LEV	371	406	$61	$38,564	$2,267	0.2%	2.7%
Motor Vehicles	Cal. Reform	291	18	$47,215	$553,301	$42,456	8.5%	111.2%
Motor Vehicles	Fed. Reform	291	8	$10,658	$553,301	$42,456	1.9%	25.1%
Motor Vehicles	Reform Diesel	291	3	$15,261	$553,301	$42,456	2.8%	36.0%

APPENDIX E

SUMMARY OF HEALTH EFFECTS AND MONETIZED HEALTH BENEFITS RESULTS FOR ALTERNATIVE OZONE NAAQS

Table E-1
Quantifiable Clinical Health End-Points

Health End-Point	Study
$DFEV_1$ [1]≥10%; 15%; and 20%	Avol et al., 1984
	Kulle et al., 1985
	McDonnell et al., 1983
	Seal et al., 1993
	Folinsbee et al., 1988; Horstman et al., 1990; and McDonnell et al., 1991
Any Lower Respiratory Symptom	Avol et al., 1984
Moderate/Severe Lower Respiratory Symptom	Avol et al., 1984
Any Cough; Moderate/Severe Cough; PDI[2]; Moderate/Severe PDI	Kulle et al., 1985
	McDonnell et al., 1983
	Seal et al., 1993
	Folinsbee et al., 1988; Horstman et al., 1990; and McDonnell et al., 1991

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[1] $DFEV_1$ means forced expiratory volume (in 1 second) decrement

[2] PDI = Pain Upon Deep Inhalation

Table E-2
Quantifiable Epidemiological Health Endpoints

Health End-Point	Study
Mortality	Dockery et al., 1992
	Dockery et al., 1992
	Kinney et al., 1995
	Moolgavkar et al., 1995
Hospital Admissions: All Respiratory Illnesses	Schwartz, 1995
Daily Respiratory Admissions	Thurston et al., 1994
Hospital Admission: Pneumonia	Schwartz, 1994a
	Schwartz, 1994b
	Schwartz, 1994c
Hospital Admissions: COPD	Schwartz, 1994a
	Schwartz, 1994b
Presence of Any of 19 Acute Respiratory Symptoms	Krupnick et al., 1990
Self-Reported Asthma Attacks	Whittemore and Korn, 1980 and U.S. EPA, 1993
Respiratory and Non-Respiratory Conditions Resulting in a Minor Restricted Activity Day (MRAD)	Ostro and Rothschild, 1989
Respiratory Restricted Activity Days	Ostro and Rothschild, 1989
Sinusitis and Hay Fever	Portney and Mullahy, 1990
Worker Productivity (resulting in changes in daily wages)	Estimated using data from Crocker and Horst (1981) and U.S. EPA, 1994c
Development of Definite Asthma	Abbey et al., 1995a; 1993

TABLE E-3
Clinical Health Effects Reductions Per Year (Year = 2007)
Regional Controls Strategies Baseline
.12 ppm, 1-Hour, 1 Exceedance Standard

Health Endpoint	Aggregated Total Incidence-Days Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
DFEV ≥ 10%	3,860,000	6,474,000	9,295,000	1,087,000	1,747,000	2,459,000
DFEV ≥ 15%	1,936,000	4,962,000	8,234,000	551,000	1,334,000	2,184,000
DFEV ≥ 20%	1,188,000	2,601,000	4,188,000	339,000	711,000	1,134,000
Any Cough[1]	5,231,000	6,693,000	8,155,000	1,475,000	1,825,000	2,174,000
Moderate to Severe Cough	459,000	1,102,000	1,745,000	189,000	359,000	528,000
Pain Upon Deep Inhalation[2]	7,246,000	12,662,000	18,077,000	1,972,000	3,375,000	4,777,000
Moderate to Severe Pain Upon Deep Inhalation	747,000	1,404,000	2,059,000	300,000	436,000	571,000
Lower Respiratory Symptoms[3]	870,000			242,000		
Moderate to Severe Lower Respiratory Symptoms	0			0		

[1]Includes moderate and severe cough.

[2]Includes moderate and severe PDI.

[3]Includes moderate and severe lower respiratory symptoms.

TABLE E-4
Clinical Health Effects Reductions Per Year (Year = 2007)
Local Controls Strategies Baseline
.12 ppm, 1-Hour, 1 Exceedance Standard

Health Endpoint	Aggregated Total Incidence-Days Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
DFEV ≥ 10%	4,520,000	7,559,000	10,839,000	1,498,000	2,421,000	3,418,000
DFEV ≥ 15%	2,264,000	5,788,000	9,595,000	756,000	1,851,000	3,033,000
DFEV ≥ 20%	1,389,000	3,030,000	4,868,000	465,000	983,000	1,566,000
Any Cough[1]	6,103,000	7,832,000	9,561,000	2,018,000	2,532,000	3,046,000
Moderate to Severe Cough	520,000	1,285,000	2,049,000	234,000	477,000	720,000
Pain Upon Deep Inhalation[2]	8,533,000	14,836,000	21,139,000	2,760,000	4,715,000	6,670,000
Moderate to Severe Pain Upon Deep Inhalation	881,000	1,649,000	2,417,000	391,000	591,000	791,000
Lower Respiratory Symptoms[3]		1,005,000			327,000	
Moderate to Severe Lower Respiratory Symptoms		126			126	

[1]Includes moderate and severe cough.

[2]Includes moderate and severe PDI.

[3]Includes moderate and severe lower respiratory symptoms.

TABLE E-5
Epidemiological Health Effects Reductions Per Year (Year = 2007)
Regional Controls Strategies Baseline
.12 ppm, 1-Hour, 1 Exceedance Standard

Health Endpoint	Aggregated Total Incidences Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	0	NE[2]	510	0	NE	130
Hospital Admissions: All Respiratory Illnesses[3]	230	430	620	60	120	170
Hospital Admissions: Pneumonia	80	110	160	20	30	40
Hospital Admissions: COPD	40	100	170	10	30	40
Presence of Any of 19 Acute Respiratory Symptoms		300,300			79,190	
Self-Reported Asthma Attacks		230			60	
Sinusitis and Hay Fever		107,260			28,130	
Development of Definite Asthma		0			0	

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-6
Epidemiological Health Effects Reductions Per Year (Year = 2007)
Local Controls Strategies Baseline
.12 ppm, 1-Hour, 1 Exceedance Standard

Health Endpoint	Aggregated Total Incidences Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	0	NE[2]	610	0	NE	190
Hospital Admissions: All Respiratory Illnesses[3]	280	530	760	90	170	250
Hospital Admissions: Pneumonia	100	130	190	30	40	60
Hospital Admissions: COPD	50	130	200	10	40	60
Presence of Any of 19 Acute Respiratory Symptoms	357,440			112,790		
Self-Reported Asthma Attacks	280			90		
Sinusitis and Hay Fever	127,780			40,280		
Development of Definite Asthma	0			0		

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-7
Clinical Health Effects Reductions Per Year (Year = 2007)
Regional Controls Strategies Baseline
.08 ppm, 8-Hour, 5 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidence-Days Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
DFEV ≥ 10%	1,206,000	2,412,000	3,663,000	640,000	1,174,000	1,736,000
DFEV ≥ 15%	571,000	1,822,000	3,107,000	312,000	901,000	1,519,000
DFEV ≥ 20%	352,000	829,000	1,321,000	192,000	446,000	717,000
Any Cough[1]	1,476,000	2,183,000	2,891,000	826,000	1,163,000	1,499,000
Moderate to Severe Cough	8,000	240,000	471,000	39,000	163,000	287,000
Pain Upon Deep Inhalation[2]	2,730,000	5,161,000	7,592,000	1,625,000	2,427,000	3,530,000
Moderate to Severe Pain Upon Deep Inhalation	39,000	378,000	717,000	94,000	227,000	360,000
Lower Respiratory Symptoms[3]		150,000			108,000	
Moderate to Severe Lower Respiratory Symptoms		0			0	

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[1]Includes moderate and severe cough.

[2]Includes moderate and severe PDI.

[3]Includes moderate and severe lower respiratory symptoms.

TABLE E-8
Clinical Health Effects Reductions Per Year (Year = 2007)
Regional Controls Strategies Baseline
.08 ppm, 8-Hour, 4 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidence-Days Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
DFEV ≥ 10%	1,424,000	2,846,000	4,316,000	704,000	1,311,000	1,943,000
DFEV ≥ 15%	673,000	2,147,000	3,661,000	342,000	1,001,000	1,690,000
DFEV ≥ 20%	415,000	971,000	1,542,000	210,000	483,000	774,000
Any Cough[1]	1,738,000	2,574,000	3,411,000	902,000	1,274,000	1,647,000
Moderate to Severe Cough	10,000	284,000	559,000	40,000	177,000	313,000
Pain Upon Deep Inhalation[2]	3,246,000	6,118,000	8,990,000	1,491,000	2,741,000	3,991,000
Moderate to Severe Pain Upon Deep Inhalation	43,000	447,000	850,000	94,000	248,000	402,000
Lower Respiratory Symptoms[3]		172,000			112,000	
Moderate to Severe Lower Respiratory Symptoms		0			0	

[1]Includes moderate and severe cough.

[2]Includes moderate and severe PDI.

[3]Includes moderate and severe lower respiratory symptoms.

TABLE E-9
Clinical Health Effects Reductions Per Year (Year = 2007)
Regional Controls Strategies Baseline
.08 ppm, 8-Hour, 1 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidence-Days Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
DFEV ≥ 10%	2,416,000	4,909,000	7,461,000	1,323,000	2,589,000	3,889,000
DFEV ≥ 15%	1,136,000	3,702,000	6,323,000	631,000	1,966,000	3,341,000
DFEV ≥ 20%	701,000	1,635,000	2,591,000	389,000	904,000	1,441,000
Any Cough[1]	2,734,000	4,381,000	6,028,000	1,580,000	2,419,000	3,257,000
Moderate to Severe Cough	11,000	484,000	956,000	42,000	302,000	563,000
Pain Upon Deep Inhalation[23]	5,642,000	10,703,000	15,763,000	2,970,000	5,570,000	8,170,000
Moderate to Severe Pain Upon Deep Inhalation	55,000	761,000	1,467,000	106,000	445,000	784,000
Lower Respiratory Symptoms	252,000			167,000		
Moderate to Severe Lower Respiratory Symptoms	0			0		

[1]Includes moderate and severe cough.

[2]Includes moderate and severe PDI.

[3]Includes moderate and severe lower respiratory symptoms.

TABLE E-10
Clinical Health Effects Reductions Per Year (Year = 2007)
Local Controls Strategies Baseline
.08 ppm, 8-Hour, 5 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidence-Days Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
DFEV ≥ 10%	1,690,000	3,351,000	5,075,000	915,000	1,721,000	2,564,000
DFEV ≥ 15%	801,000	2,544,000	4,338,000	444,000	1,326,000	2,247,000
DFEV ≥ 20%	493,000	1,178,000	1,883,000	273,000	654,000	1,058,000
Any Cough[1]	2,075,000	3,096,000	4,117,000	1,171,000	1,690,000	2,209,000
Moderate to Severe Cough	10,000	340,000	671,000	46,000	226,000	406,000
Pain Upon Deep Inhalation[23]	3,804,000	7,151,000	10,499,000	1,925,000	3,573,000	5,221,000
Moderate to Severe Pain Upon Deep Inhalation	60,000	530,000	1,000,000	114,000	317,000	520,000
Lower Respiratory Symptoms		216,000			149,000	
Moderate to Severe Lower Respiratory Symptoms		0			0	

[1]Includes moderate and severe cough.

[2]Includes moderate and severe PDI.

[3]Includes moderate and severe lower respiratory symptoms.

TABLE E-11
Clinical Health Effects Reductions Per Year (Year = 2007)
Local Controls Strategies Baseline
.08 ppm, 8-Hour, 4 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidence-Days Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
DFEV ≥ 10%	2,000,000	3,973,000	6,013,000	1,049,000	1,990,000	2,972,000
DFEV ≥ 15%	949,000	3,014,000	5,138,000	507,000	1,531,000	2,596,000
DFEV ≥ 20%	584,000	1,390,000	2,219,000	312,000	749,000	1,210,000
Any Cough[1]	2,454,000	3,672,000	4,890,000	1,337,000	1,943,000	2,550,000
Moderate to Severe Cough	12,000	405,000	798,000	48,000	255,000	462,000
Pain Upon Deep Inhalation[23]	4,531,000	8,509,000	12,488,000	2,230,000	4,157,000	6,085,000
Moderate to Severe Pain Upon Deep Inhalation	69,000	629,000	1,189,000	121,000	361,000	600
Lower Respiratory Symptoms	250,000			165,000		
Moderate to Severe Lower Respiratory Symptoms	0			0		

[1]Includes moderate and severe cough.

[2]Includes moderate and severe PDI.

[3]Includes moderate and severe lower respiratory symptoms.

TABLE E-12
Clinical Health Effects Reductions Per Year (Year = 2007)
Local Controls Strategies Baseline
.08 ppm, 8-Hour, 1 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidence-Days Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
DFEV ≥ 10%	3,366,000	6,778,000	10,283,000	1,795,000	3,519,000	5,302,000
DFEV ≥ 15%	1,586,000	5,134,000	8,763,000	858,000	2,691,000	4,583,000
DFEV ≥ 20%	978,000	2,321,000	3,694,000	528,000	1,269,000	2,041,000
Any Cough[1]	3,995,000	6,185,000	8,375,000	2,324,000	3,340,000	4,356,000
Moderate to Severe Cough	15,000	679,000	1,343,000	50,000	407,000	765,000
Pain Upon Deep Inhalation[2]	7,787,000	14,708,000	21,629,000	3,982,000	7,508,000	11,034,000
Moderate to Severe Pain Upon Deep Inhalation	92,000	1,060,000	2,029,000	139,000	597,000	1,055,000
Lower Respiratory Symptoms[3]		368,000			240,000	
Moderate to Severe Lower Respiratory Symptoms		0			0	

[1]Includes moderate and severe cough.

[2]Includes moderate and severe PDI.

[3]Includes moderate and severe lower respiratory symptoms.

TABLE E-13
Epidemiological Health Effects Reductions Per Year (Year = 2007)
Regional Controls Strategies Baseline
.08 ppm, 8-Hour, 5 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidences Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	0	NE[2]	220	0	NE	110
Hospital Admissions: All Respiratory Illnesses[3]	100	190	270	50	100	140
Hospital Admissions: Pneumonia	40	50	70	20	20	40
Hospital Admissions: COPD	20	50	70	10	20	40
Presence of Any of 19 Acute Respiratory Symptoms		131,960			59,530	
Self-Reported Asthma Attacks		100			50	
Sinusitis and Hay Fever		46,030			22,290	
Development of Definite Asthma		0			0	

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-14
Epidemiological Health Effects Reductions Per Year (Year = 2007)
Regional Controls Strategies Baseline
.08 ppm, 8-Hour, 4 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidences Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	0	NE[2]	260	0	NE	120
Hospital Admissions: All Respiratory Illnesses[3]	120	230	320	60	110	160
Hospital Admissions: Pneumonia	40	60	80	20	30	40
Hospital Admissions: COPD	20	60	90	10	30	40
Presence of Any of 19 Acute Respiratory Symptoms	155,410			68,360		
Self-Reported Asthma Attacks	120			50		
Sinusitis and Hay Fever	54,400			25,280		
Development of Definite Asthma	0			0		

[1]Low estimate is result of Kenney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-15
Epidemiological Health Effects Reductions Per Year (Year = 2007)
Regional Controls Strategies Baseline
.08 ppm, 8-Hour, 1 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidences Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	0	NE[2]	470	0	NE	250
Hospital Admissions: All Respiratory Illnesses[3]	230	430	600	120	240	330
Hospital Admissions: Pneumonia	80	110	160	40	60	80
Hospital Admissions: COPD	40	100	160	20	60	90
Presence of Any of 19 Acute Respiratory Symptoms	275,430			141,720		
Self-Reported Asthma Attacks	210			110		
Sinusitis and Hay Fever	96,790			51,640		
Development of Definite Asthma	0			0		

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-16
Epidemiological Health Effects Reductions Per Year (Year = 2007)
Local Controls Strategies Baseline
.08 ppm, 8-Hour, 5 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidences Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	0	NE[2]	310	0	NE	160
Hospital Admissions: All Respiratory Illnesses[3]	150	280	390	80	150	210
Hospital Admissions: COPD	50	70	100	30	40	50
Hospital Admissions: Pneumonia	30	70	110	10	40	60
Presence of Any of 19 Acute Respiratory Symptoms	179,070			85,480		
Self-Reported Asthma Attacks	140			70		
Sinusitis and Hay Fever	64,060			32,400		
Development of Definite Asthma	0			0		

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-17
Epidemiological Health Effects Reductions Per Year (Year = 2007)
Local Controls Strategies Baseline
.08 ppm, 8-Hour, 4 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidences Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	0	NE[2]	370	0	NE	180
Hospital Admissions: All Respiratory Illnesses[3]	180	340	480	90	170	250
Hospital Admissions: Pneumonia	60	80	120	30	40	60
Hospital Admissions: COPD	30	80	130	20	40	70
Presence of Any of 19 Acute Respiratory Symptoms	214,290			99,930		
Self-Reported Asthma Attacks	170			80		
Sinusitis and Hay Fever	76,760			37,870		
Development of Definite Asthma	0			0		

[1]Low estimate is result of Kinney et al. model, High estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-18
Epidemiological Health Effects Reductions Per Year (Year = 2007)
Local Controls Strategies Baseline
.08 ppm, 8-Hour, 1 Exceedance Standard
(Estimates are incremental from the current standard)

Health Endpoint	Aggregated Total Incidences Reduced					
	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	0	NE[2]	660	0	NE	340
Hospital Admissions: All Respiratory Illnesses[3]	330	630	890	175	330	480
Hospital Admissions: Pneumonia	110	150	230	60	80	120
Hospital Admissions: COPD	60	150	240	30	80	130
Presence of Any of 19 Acute Respiratory Symptoms	376,260			185,250		
Self-Reported Asthma Attacks	290			140		
Sinusitis and Hay Fever	135,060			68,990		
Development of Definite Asthma	0			0		

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-19
Monetized Benefits for Clinical Approach
.12 ppm, 1-Hour, 1 Exceedance Standard
(1990 $)

Health Endpoint	REGIONAL CONTROL STRATEGIES BASELINE		
		Full Attainment Scenario	Partial Attainment Scenario
Cough	Low Estimate	$580,000	$240,000
	Best Estimate	$7,710,000	$2,510,000
	High Estimate	$24,150,000	$7,310,000
Pain Upon Deep Inhalation	Low Estimate	$9,130,000	$2,480,000
	Best Estimate	$55,840,000	$14,880,000
	High Estimate	$506,890,000	$1,333,960,000
Total Monetized Benefits	Low Estimate	$9,710,000	$2,720,000
	Best Estimate	$63,550,000	$17,390,000
	High Estimate	$531,030,000	$141,270,000
LOCAL CONTROL STRATEGIES BASELINE			
Cough	Low Estimate	$7,690,000	$2,540,000
	Best Estimate	$54,820,000	$17,720,000
	High Estimate	$132,320,000	$42,160,000
Pain Upon Deep Inhalation	Low Estimate	$10,750,000	$3,480,000
	Best Estimate	$65,430,000	$20,790,000
	High Estimate	$592,730,000	$187,020,000
Total Monetized Benefits	Low Estimate	$18,440,000	$6,020,000
	Best Estimate	$120,250,000	$38,520,000
	High Estimate	$725,050,000	$229,180,000

TABLE E-20
Monetized Benefits for Epidemiological Approach
Regional Controls Strategies Baseline
.12 ppm, 1-Hour, 1 Exceedance Standard
(1990 $)

Health Endpoint	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	$0	NE[2]	$2,459,973,000	$0	NE	$645,335,000
Hospital Admissions: All Respiratory Illnesses[3]	$2,763,000	$5,198,000	$7,361,000	$736,000	$1,414,000	$2,018,000
Hospital Admissions: Pneumonia	$1,182,000	$1,606,000	$2,373,000	$312,000	$425,000	$630,000
Hospital Admissions: COPD	$655,000	$1,611,000	$2,568,000	$173,000	$428,000	$683,000
Presence of Any of 19 Acute Respiratory Symptoms	$1,117,000	$8,808,000	$16,498,000	$295,000	$2,323,000	$4,351,000
Self-Reported Asthma Attacks	$3,000	$8,000	$12,000	$1,000	$2,000	$3,000
Worker Productivity		$860,000			$424,000	
Total Monetized Benefits	$6,581,000	$18,091,000	$2,489,646,000	$1,941,000	$5,016,000	$653,444,000

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[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-21
Monetized Benefits for Epidemiological Approach
Local Control Strategies Baseline
.12 ppm, 1-Hour, 1 Exceedance Standard
(1990 $)

Health Endpoint	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	$0	NE[2]	$2,938,005,000	$0	NE	$927,600,000
Hospital Admissions: All Respiratory Illnesses[3]	$3,379,000	$6,398,000	$9,083,000	$1,072,000	$2,067,000	$2,956,000
Hospital Admissions: Pneumonia	$1,442,000	$1,960,000	$2,899,000	$454,000	$618,000	$917,000
Hospital Admissions: COPD	$799,000	$1,969,000	$3,138,000	$252,000	$622,000	$993,000
Presence of Any of 19 Acute Respiratory Symptoms	$1,330,000	$10,484,000	$19,638,000	$420,000	$3,308,000	$6,197,000
Self-Reported Asthma Attacks	$3,000	$9,000	$15,000	$1,000	$3,000	$5,000
Worker Productivity		$1,852,000			$1,172,000	
Total Monetized Benefits	$8,806,000	$22,672,000	$2,974,629,000	$3,370,000	$7,791,000	$939,840,000

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-22
Monetized Benefits for Clinical Approach
Regional Controls Strategies Baseline
(1990 $)
(Estimates are incremental from the current standard)

Health Endpoint	FULL ATTAINMENT SCENARIO			
		.08 ppm, 8-Hour, 5 Exc.	.08 ppm, 8-Hour, 4 Exc.	.08 ppm, 8-Hour, 1 Exc.
Cough	Low Estimate	$10,000	$12,000	$14,000
	Best Estimate	$1,680,000	$1,990,000	$3,380,000
	High Estimate	$6,520,000	$7,740,000	$13,230,000
Pain Upon Deep Inhalation	Low Estimate	$3,440,000	$4,090,000	$7,110,000
	Best Estimate	$22,760,000	$26,980,000	$47,200,000
	High Estimate	$212,880,000	$252,090,000	$442,000,000
Total Monetized Benefits	Low Estimate	$3,450,000	$4,100,000	$7,120,000
	Best Estimate	$24,440,000	$28,970,000	$50,580,000
	High Estimate	$219,400,000	$259,830,000	$455,230,000
PARTIAL ATTAINMENT SCENARIO				
Cough	Low Estimate	$49,000	$50,000	$50,000
	Best Estimate	$1,140,000	$1,240,000	$2,120,000
	High Estimate	$3,970,000	$4,340,000	$7,790,000
Pain Upon Deep Inhalation	Low Estimate	$1,670,000	$1,880,000	$3,740,000
	Best Estimate	$10,700,000	$12,090,000	$24,560,000
	High Estimate	$98,970,000	$111,920,000	$229,070,000
Total Monetized Benefits	Low Estimate	$1,720,000	$1,930,000	$3,800,000
	Best Estimate	$11,850,000	$13,330,000	$26,680,000

	High Estimate	$102,940,000	$116,260,000	$236,860,000

TABLE E-23
Monetized Benefits for Clinical Approach
Local Controls Strategies Baseline
(1990 $)
(Estimates are incremental from the current standard)

Health Endpoint		FULL ATTAINMENT SCENARIO		
		.08 ppm, 8-Hour, 5 Exc.	.08 ppm, 8-Hour, 4 Exc.	.08 ppm, 8-Hour, 1 Exc.
Cough	Low Estimate	$2,620,000	$3,090,000	$5,030,000
	Best Estimate	$21,670,000	$25,700,000	$43,300,000
	High Estimate	$56,980,000	$67,670,000	$115,920,000
Pain Upon Deep Inhalation	Low Estimate	$4,790,000	$5,710,000	$9,810,000
	Best Estimate	$31,540,000	$37,530,000	$64,860,000
	High Estimate	$294,380,000	$350,160,000	$606,480,000
Total Monetized Benefits	Low Estimate	$7,410,000	$8,800,000	$14,850,000
	Best Estimate	$53,210,000	$63,230,000	$108,160,000
	High Estimate	$351,350,000	$417,840,000	$722,390,000
PARTIAL ATTAINMENT SCENARIO				
Cough	Low Estimate	$1,480,000	$1,680,000	$2,930,000
	Best Estimate	$11,830,000	$13,600,000	$23,380,000
	High Estimate	$30,570,000	$35,300,000	$60,290,000
Pain Upon Deep Inhalation	Low Estimate	$2,430,000	$2,810,000	$5,020,000
	Best Estimate	$15,760,000	$18,330,000	$33,110,000
	High Estimate	$1,466,400,000	$170,620,000	$309,380,000
Total Monetized Benefits	Low Estimate	$3,900,000	$4,490,000	$7,950,000
	Best Estimate	$27,590,000	$31,940,000	$56,490,000

	High Estimate	$176,970,000	$205,910,000	$369,670,000

TABLE E-24
Monetized Benefits for Epidemiological Approach
Regional Controls Strategies Baseline
.08 ppm, 8-Hour, 5 Exceedance Standard
(1990 $)
(Estimates are incremental from the current standard)

Health Endpoint	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	$0	NE[2]	$1,070,989,000	$0	NE	$518,435,000
Hospital Admissions: All Respiratory Illnesses[3]	$1,222,000	$2,270,000	$3,188,000	$608,000	$1,173,000	$1,664,000
Hospital Admissions: Pneumonia	$533,000	$720,000	$1,056,000	$256,000	$358,000	$522,000
Hospital Admissions: COPD	$297,000	$716,000	$1,136,000	$147,000	$351,000	$570,000
Presence of Any of 19 Acute Respiratory Symptoms	$491,000	$3,870,000	$7,250,000	$221,000	$1,746,000	$3,271,000
Self-Reported Asthma Attacks	$1,000	$3,000	$5,000	$1,000	$1,000	$2,000
Worker Productivity		$1,179,000			$939,000	
Total Monetized Benefits	$3,723,000	$8,759,000	$1,084,803,000	$2,172,000	$4,567,000	$525,402,000

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-25
Monetized Benefits for Epidemiological Approach
Regional Controls Strategies Baseline
.08 ppm, 8-Hour, 4 Exceedance Standard
(1990 $)
(Estimates are incremental from the current standard)

Health Endpoint	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	$0	NE[2]	$1,266,681,000	$0	NE	$588,776,000
Hospital Admissions: All Respiratory Illnesses[3]	$1,475,000	$2,752,000	$3,874,000	$683,000	$1,315,000	$1,865,000
Hospital Admissions: Pneumonia	$640,000	$867,000	$1,273,000	$288,000	$401,000	$586,000
Hospital Admissions: COPD	$356,000	$863,000	$1,370,000	$165,000	$395,000	$640,000
Presence of Any of 19 Acute Respiratory Symptoms	$578,000	$4,558,000	$8,538,000	$254,000	$2,005,000	$3,755,000
Self-Reported Asthma Attacks	$1,000	$4,000	$6,000	$1,000	$2,000	$3,000
Worker Productivity		$1,582,000			$1,131,000	
Total Monetized Benefits	$4,633,000	$10,626,000	$1,283,325,000	$2,523,000	$5,249,000	$596,757,000

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-26
Monetized Benefits for Epidemiological Approach
Regional Controls Strategies Baseline
.08 ppm, 8-Hour, 1 Exceedance Standard
(1990 $)
(Estimates are incremental from the current standard)

Health Endpoint	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	$0	NE[2]	$2,257,144,000	$0	NE	$1,205,279,000
Hospital Admissions: All Respiratory Illnesses[3]	$2,731,000	$5,117,000	$7,226,000	$1,470,000	$2,809,000	$3,989,000
Hospital Admissions: Pneumonia	$1,177,000	$1,596,000	$2,350,000	$624,000	$858,000	$1,262,000
Hospital Admissions: COPD	$654,000	$1,595,000	$2,537,000	$351,000	$853,000	$1,371,000
Presence of Any of 19 Acute Respiratory Symptoms	$1,025,000	$8,078,000	$15,132,000	$527,000	$4,157,000	$7,786,000
Self-Reported Asthma Attacks	$3,000	$7,000	$11,000	$1,000	$4,000	$6,000
Worker Productivity		$4,573,000			$3,364,000	
Total Monetized Benefits	$10,161,000	$20,967,000	$2,288,974,000	$6,338,000	$12,044,000	$1,223,055,000

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-27
Monetized Benefits for Epidemiological Approach
Local Controls Strategies Baseline
.08 ppm, 8-Hour, 5 Exceedance Standard
(1990 $)
(Estimates are incremental from the current standard)

Health Endpoint	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	$0	NE[2]	$1,489,073,000	$0	NE	$752,269,000
Hospital Admissions: All Respiratory Illnesses[3]	$1,768,000	$3,303,000	$4,654,000	$911,000	$1,747,000	$2,494,000
Hospital Admissions: Pneumonia	$764,000	$1,024,000	$1,515,000	$390,000	$529,000	$781,000
Hospital Admissions: COPD	$413,000	$1,030,000	$1,648,000	$220,000	$536,000	$851,000
Presence of Any of 19 Acute Respiratory Symptoms	$666,000	$5,252,000	$9,838,000	$318,000	$2,507,000	$4,696,000
Self-Reported Asthma Attacks	$2,000	$4,000	$7,000	$1,000	$2,000	$4,000
Worker Productivity	$3,208,000			$2,438,000		
Total Monetized Benefits	$6,820,000	$13,821,000	$1,509,943,000	$4,278,000	$7,759,000	$763,533,000

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates ar efor hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-28
Monetized Benefits for Epidemiological Approach
Local Controls Strategies Baseline
.08 ppm, 8-Hour, 4 Exceedance Standard
(1990 $)
(Estimates are incremental from the current standard)

Health Endpoint	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	$0	NE[2]	$1,785,713,000	$0	NE	$880,132,000
Hospital Admissions: All Respiratory Illnesses[3]	$2,153,000	$4,035,000	$5,696,000	$1,083,000	$2,076,000	$2,963,000
Hospital Admissions: Pneumonia	$929,000	$1,248,000	$1,846,000	$463,000	$629,000	$928,000
Hospital Admissions: COPD	$504,000	$1,255,000	$2,006,000	$260,000	$635,000	$1,011,000
Presence of Any of 19 Acute Respiratory Symptoms	$797,000	$6,285,000	$11,773,000	$372,000	$2,931,000	$5,490,000
Self-Reported Asthma Attacks	$2,000	$5,000	$9,000	$1,000	$3,000	$4,000
Worker Productivity		$4,155,000			$3,084,000	
Total Monetized Benefits	$8,540,000	$16,983,000	$1,811,198,000	$5,263,000	$9,357,000	$893,611,000

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Esitmates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.

TABLE E-29
Monetized Benefits for Epidemiological Approach
Local Controls Strategies Baseline
.08 ppm, 8-Hour, 1 Exceedance Standard
(1990 $)
(Estimates are incremental from the current standard)

Health Endpoint	FULL ATTAINMENT SCENARIO			PARTIAL ATTAINMENT SCENARIO		
	Low Estimate	Best Estimate	High Estimate	Low Estimate	Best Estimate	High Estimate
Mortality[1]	$0	NE[2]	$3,147,511,000	$0	NE	$1,606,999,000
Hospital Admissions: All Respiratory Illnesses[3]	$3,988,000	$7,501,000	$10,612,000	$2,093,000	$3,996,000	$5,692,000
Hospital Admissions: Pneumonia	$1,713,000	$2,313,000	$3,421,000	$893,000	$1,214,000	$1,794,000
Hospital Admissions: COPD	$939,000	$2,325,000	$3,711,000	$499,000	$1,224,000	$1,948,000
Presence of Any of 19 Acute Respiratory Symptoms	$1,400,000	$11,036,000	$20,671,000	$689,000	$5,433,000	$10,177,000
Self-Reported Asthma Attacks	$3,000	$9,000	$16,000	$2,000	$5,000	$8,000
Worker Productivity	$11,199,000			$8,161,000		
Total Monetized Benefits	$19,242,000	$34,383,000	$3,197,141,000	$12,337,000	$20,032,000	$1,634,780,000

[1]Low estimate is result of Kinney et al. model, high estimate is result of Moolgavkar et al. model.

[2]NE = not estimated due to uncertainty considerations.

[3]Estimates are for hospital admissions for all respiratory illnesses excluding admissions for pneumonia or COPD.