FINAL SOCIOECONOMIC REPORT
FOR THE FINAL 2003 AQMP

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SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

FINAL SOCIOECONOMIC REPORT
FOR
2003 AIR QUALITY MANAGEMENT PLAN

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The Southern California Association of Governments provided valuable technical assistance relative to the cost and benefit of transportation projects and baseline economic forecasts.

Preface

Since its release in May 2003, the draft Socioeconomic Report has been further revised to reflect the proposed modifications to the draft AQMP which were released to the public in June 2003 (hereafter referred to as the draft final 2003 AQMP). The major differences of the draft and draft final 2003 AQMPs that are critical to the socioeconomic analysis are:

1. Control Measure OFF-RD CI-1 (Lower Emission Standards for New Off-road Compression Ignition Engines) in the draft 2003 AQMP is deleted from the draft final 2003 AQMP, thereby resulting in a less than one percent reduction in the average annual cost for the quantified measures in the draft final Socioeconomic Report.
2. CARB has revised its cost effectiveness numbers, resulting in lower average cost effectiveness numbers for the CARB area source measures and off-road measures, respectively, and a higher average cost effectiveness number for on-road measures than those in the draft Socioeconomic Report.
3. Emission reductions for Tier II Long-term Measure were revised upward relative to the draft 2003 AQMP. This and the revision in (2) have resulted in a 14 percent increase in the 2010 cost estimate for the unquantified measures compared to the draft Socioeconomic Report.
4. The revisions in (1) through (3) yield a six percent increase in the total cost of the draft final 2003 AQMP compared to the draft 2003 AQMP.
5. The visibility calculations in the draft final 2003 AQMP use the direct output of the revised UAMAERO-LT simulation in the visibility regression equations. This is in contrast to the methodology used in the draft 2003 AQMP and previous AQMPs that relied on the use of a combination of speciated and apportioned rollback PM10 component concentrations and selected modeled secondary component concentrations in the visibility equations. This methodology revision brings the visibility benefit ($3.9 billion) in the draft Socioeconomic Report to $1.9 billion.
6. The revision to the 2010 baseline VHT by SCAG results in approximately $600 million additional congestion relief benefit. Minor revisions were made to the allocation of the congestion relief benefit from the reduction in VMT to different consumption categories, resulting in a reduction of the average annual benefit by $2 million (representing 0.47 percent of the VMT benefit in the draft Socioeconomic Report).
7. The draft final air quality modeling results lead to lower morbidity ($453 vs. $449 million), agricultural ($19 vs. $18 million), and material ($70 vs. $63 million) benefits but a higher mortality benefit ($1,472 vs. $2,130 million) compared to the draft Socioeconomic Report. In some cases, the sub-regional distribution has changed.

Finally, the emission reduction allocation file was revised to reflect the exclusion of federal NOx sources from the Less NOx Reduction, and More VOC and Less NOx Reduction alternatives, thereby resulting in fewer costs for these two alternatives in the draft final socioeconomic analysis than those in the draft version. In the draft Socioeconomic Report, the cost calculation did not reflect the exclusion of these sources in the emission reduction allocation file. All the changes described herein were reflected in the inputs to the REMI model. Consequently, the results from the REMI model are revised as well.

The italicized texts throughout this report reflect the differences between the draft and draft final socioeconomic reports.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The final 2003 Air Quality Management Plan (AQMP or Plan) has been prepared to meet the challenge of achieving healthful air quality in the South Coast Air Basin (Basin) and the Coachella valley. This report accompanies the AQMP and presents the potential socioeconomic impacts resulting from implementation of this Plan. The information contained herein is considered by the South Coast Air Quality Management District (AQMD) Governing Board when determining whether or not to approve the Plan.

The final Plan contains several short- and long-term strategies designed to achieve state and federal ambient air quality standards, and air quality planning requirements. These strategies will be implemented by the AQMD, the California Air Resources Board (CARB), the U.S. Environmental Protection Agency (U.S. EPA), and other local and regional governments. Implementation of these control strategies will affect the region's economy.

The AQMD relies on a number of methods, tools, and data sources to determine the impact of proposed control strategies on the economy. These tools include the following: air quality models and concentration-response relationships to estimate benefits of clean air; costs and emission reductions to calculate the efficiency of the draft final Plan; the REMI (Regional Economic Models, Inc.) model to assess any potential employment and other socioeconomic impacts; the 1990 and 2000 census data and the Current Population Survey to assess how employment impacts affect ethnic groups; and the consumer expenditure survey and changes in product prices to examine the impact on consumer price indexes by income group.

Based on the methods and tools described above, the socioeconomic assessment attempts to answer the following important questions.

What Are the Benefits of the Final 2003 AQMP?

In recent years, there have been significant improvements in air quality in the Basin. Additional control is still needed in order to bring the Basin into compliance with the federal air quality standards. The benefits of better air quality through implementation of the draft final 2003 AQMP include increases in crop yields, visibility improvements, and a reduction in morbidity, higher survival rates, reduced expenditures on refurbishing building surfaces, and reduced traffic congestion.

Compliance with the federal PM10 and ozone standards and continual progress toward the state visibility standard is projected to result in an average annual benefit of $6.6 billion. The $6.6 billion includes roughly $2.6 billion for averted illness and higher survival rates, $2 billion for congestion relief, $1.9 billion for visibility improvements, $63 million for reduced damage to materials, and $18 million for increased crop yields.

The total benefits of the draft final Plan are expected to exceed $6.6 billion since not all of the benefits associated with the implementation of the Plan can be quantified. For example, the quantified health benefits only account for reduced emissions from PM10 and ozone, while those from emission reductions of other pollutants are not included. In addition, reductions in vehicle hours traveled for personal trips and damages to plants, livestock, and forests have not been quantified. Further research is needed before the benefits of these effects of the 2003 AQMP can be quantified.

What Is the Total Implementation Cost of the Draft Final 2003 AQMP?

The projected annual implementation cost of the draft final Plan is $3.2 billion annually, on average. The cost estimate is divided into quantifiable and unquantifiable measures.

The projected cost for 31 quantifiable short-term measures and some long-term measures is approximately $1.6 billion. Transportation control measures alone contribute to 57 percent of the total quantifiable cost. The cost of unquantifiable measures is projected to be approximately $1.6 billion. The cost of unquantified measures was derived from emission reductions in 2010 and the average cost effectiveness of quantifiable measures.

The cost of quantified measures represents only 30 percent of emission reductions intended for attainment. A sensitivity test rendered on the unquantified measures shows that the total cost of the draft final Plan could range from a low of $2 to a high of $4.7 billion annually, on average. Additional efforts will be made to quantify the costs associated with all control measures before the next AQMP revision.

What Is the Cost of the Draft Final 2003 AQMP as Compared to the Benefits?

The cost of quantifiable measures was based on the prices of equipment and materials that would be required for its implementation. The cost of unquantified measures was assessed based on the average cost effectiveness of quantified measures. Since quantifiable measures represent only 30 percent of emissions reductions, questions have been raised about the appropriateness of this approach. This is because as the AQMD comes closer to its attainment goals for various pollutants, the cost in achieving the final increment towards attainment might actually result in higher costs than projected. It is also not clear whether the costs associated with maintaining attainment of various pollutants will be reflective of the currently projected costs. On the other hand, historically actual costs are generally thought to be lower than the projected costs due to cost reductions resulting from technological advancements over time.

The measurement of clean air benefits is performed indirectly since clean air is not a commodity purchased or sold in a market. This often results in incomplete and underestimated benefits. The benefits of clean air (based on the total emission reductions required for attainment) for which a monetary figure can be applied are $6.6 billion as compared to the costs of $3.2 billion on an average annual basis. There are, however, many benefits which are still unaccounted for, such as reductions in chronic illness and lung function impairment in human beings as well as reduced damage to livestock and plant life, erosion of building materials, and the value of reduced vehicle hours traveled for personal trips. When all these are considered, the estimated benefits will further outweigh the costs.

What Effect Will the Plan Have on Employment?

The employment impact analysis was performed separately for quantified control measures and clean air benefits resulting from the attainment of air quality standards (federal 1-hour ozone and PM10 and state visibility standards) since quantified control measures represent only 30 percent of the total emission reductions required for meeting the air quality standards and quantification of benefits includes all the intended emission reductions. As such, the employment impacts from quantified measures and benefits should be viewed separately.

Without the AQMP, jobs in the four-county area are projected to grow at an annual rate of about 1.069 percent between 2002 and 2020. Cleaner air would result in 41,934 jobs created annually, on average. This would bring the job growth rate to an annual rate of 1.1 percent. On the other hand, the quantified measures are projected to result in 9,893 jobs forgone annually, on average, which would slow down the job growth rate to 1.054 percent relative to the baseline employment. The four-county region is projected to have 11 million jobs in 2020. The jobs created from clean air benefits would amount to 0.57 percent of the 2020 baseline jobs. The jobs forgone from quantified measures would be 0.2 percent of the 2020 baseline jobs.

The medical sector would experience jobs forgone due to reductions in illness from cleaner air. The industries of construction and auto repair services and manufacturers of transportation equipment would experience additional jobs created due to additional demand for their products as required by on- and off-road control measures.

The employment impacts associated with unquantified measures will be examined further as the costs of these measures are estimated in more detail. In addition, as measures are developed into rules, their potential employment impacts will be specifically assessed.

What Are the Potential Impacts on Socioeconomic Groups and Ethnic Communities?

Implementation of the final 2003 AQMP is projected to result in air quality improvements sufficient to attain the air quality standards by 2010 throughout the Basin. The air quality modeling results have, however, shown the greatest relative improvements and air quality benefit in the eastern portion of the Basin. The Chino-Redlands area is shown to have the greatest share of the monetary value of these improvements. A demographic analysis of the 2000 census showed that 45 percent of the population there is Hispanics and 36 percent Whites. The minority population increased from 45 percent in the 1990 census to 64 percent in the 2000 census.

The attainment of the air quality standards in 2010 depends on a full implementation of control measures, as proposed in the final 2003 AQMP. The costs of these measures will spread throughout various communities. The cost of quantified control measures that represent 30 percent of the total emission reductions towards clean air would exert a relatively higher share on the southern portion of Los Angeles County and the Chino-Redlands area than the rest of the communities.

All the 19 sub-regions are projected to have additional jobs created from cleaner air. All the ethnic groups are expected to have job gains as a result. The share of Whites and Hispanics in job gains is projected to be 84 percent with other ethnic groups representing the balance. Implementation of quantified control measures would also result in additional jobs to be created between 2002 and 2006 of which Whites are projected to have a 54 percent share and Hispanics would have a 32 percent share. In later years (2007 to 2020), these measures would result in an average of 19,761 jobs forgone annually of which the share of Hispanics is 25 percent.

Job gains from cleaner air would vary slightly among five wage groups comprised of 94 occupations. There is no significant difference in impacts on the price of consumption goods from one income group to another.

What Effect Will the Draft Final Plan Have on Industrial Competitiveness?

The socioeconomic report examines industrial competitiveness in three areas: the Basin's share of national jobs, product prices and profits, and exports and imports. The quantified measures and benefits of the draft final 2003 AQMP are not expected to result in discernible differences in the four-county region's share of national jobs. For the majority of sectors, the impact on product prices is projected to be less than one-half of one percent of the baseline index of product prices and the impact on profits is projected to be less than one-half of one percent of the baseline index of profits. The impact on imports and exports is small as well, especially when the size of the four-county region is considered.

The competitiveness analysis of the Plan focuses on its impact on various sectors of the local economy. Individual control measures could result in impacts on individual companies. Competitiveness at the company level will be analyzed during individual rule adoption proceedings.

Competing regions tend to follow the South Coast Basin and adopt similar control measures, thereby reducing potential imbalances. The costs of the unquantified measures may affect competitiveness if they are implemented solely in the South Coast region. At the same time, the socioeconomic analysis underestimates the benefits from clean air that would increase regional attractiveness.

Future research is required to assess the impact of innovation on competitiveness. In addition, the AQMD will examine the impact of proposed air quality regulations on competitiveness during the rulemaking process for each proposed rule.

Does This Analysis Affect the Selection of Possible Alternatives to the Final 2003 AQMP?

Yes. The Socioeconomic Report can affect the selection of possible alternatives to the proposed Plan as identified in the final program EIR (PEIR) for the 2003 AQMP. In considering whether to adopt the Plan or one of the alternatives, the AQMD Governing Board will evaluate which alternative presents the best balance of greatest socioeconomic and environmental benefits and least adverse environmental and socioeconomic impacts.

The No Project alternative would not reach the attainment of air quality standards. All other alternatives display fewer variations in monetary costs than in monetary benefits, especially when uncertainty for the unquantified measures is considered. Except for the No Project alternative, the job impact of quantified measures shows more variations among alternatives than that of quantified benefits.

What are the Key Areas of Uncertainty in This Assessment?

It is not possible at this time to quantify the costs associated with every control measure and all of the benefits associated with clean air. Of the 40 control measures required for attainment demonstration, 36 have quantifiable costs which represent only 30 percent of the total emission reductions. Costs for the remaining four measures are not available at this time because control methods, control efficiencies, emission reductions, or the costs of control technologies are not presently defined. In addition, it is also not possible at this time to quantify every beneficial effect of clean air.

The REMI model, which was used to analyze the impacts of the 2003 AQMP, projects possible impacts on jobs, the distribution of jobs, income, product prices, profits, exports, and imports based upon the input of cost data for each quantified control measure and the quantifiable benefit data for each effect of clean air. The reliability of such projections is dependent upon the validity of the input.

The relatively large size of emission reductions from unquantified measures and the limited data currently available do not lend themselves to carry forward such projections for unquantified measures. To determine the potential impacts as described above, therefore, only the quantified measures and benefits are utilized. This analysis is performed separately for quantified measures and clean air benefits because the cost of these measures reflects only 30 percent of the total emission reductions while 100 percent of emission reductions were included in attainment demonstration in air quality models. Changes in pollutant concentrations from these models serve the basis for clean air benefit assessments which then become input to the REMI model.

What Efforts Will Be Taken to Refine the AQMD's Socioeconomic Analyses?

Several powerful tools have been developed to determine the socioeconomic impacts of the 2003 AQMP. However, additional data and research are still required. Table ES-1 shows the enhancements achieved since the 1997 AQMP socioeconomic analysis and future research efforts that the AQMD plans to take before the next AQMP. Some of the research efforts identified in Table ES-1 are carried over from the previous AQMPs. They have not been implemented because of funding constraints and/or lack of advancements in the subject field.

TABLE ES-1

Enhancements Achieved and Proposed for Future Action

Topic	Achieved	Proposed for Future
Benefit **Quantitative & Qualitative Benefit Assessments**	• Quantify benefits from reductions in vehicle hours traveled. • Assess benefits for greater geographical details • Update the visibility benefit estimate. • Establish air quality research center to further assess health impacts.	• Estimate changes in life expectancy (1997).[1] • Separate multiple pollutant effects (1997). • Examine at-risk population (1997).
Cost **Evaluation of Costs and Flexible Regulatory Approaches**	• Quantify costs at source locations. • Continue the use of the mitigation fee and emission fee concepts.	• Examine differences between command-and-control regulations and pricing or subsidies (1994).[2] • Work with the CARB to examine post rule costs.
Distributional Impacts **Geographic Information System (GIS)**	• Develop facility based assessment to analyze specific segments of affected industries. • Analyze macroeconomic impacts at sub-county level for differential impacts.	• Produce more detailed sub-region analyses through GIS. • Merge air quality, land use, and socioeconomic models.
Competitiveness **Impact of Regional Regulations on Competitiveness**	• Use firm and industry profiles to perform segmentation study of an industry.	• Assess the impact of innovation on competitiveness. (1994) • Build time series database for trend analysis. • Convert to the North American Industrial Classification System (NAICS) for comparable statistics.

[1]Origionally proposed in the 1997 AQMP Socioeconomic Report.
[2]Origionally proposed in the 1994 AQMP Socioeconomic Report.

CHAPTER 1

INTRODUCTION

INTRODUCTION

The 2003 Air Quality Management Plan (AQMP or Plan) is designed to meet the challenge of achieving clean air in Southern California. The final Plan proposes strategies and programs aimed at both a healthy environment and economy. The costs of implementing the draft final Plan and the associated benefits of achieving clean air standards are the subject of this report. The purpose of this assessment is to define and present the potential socioeconomic impacts related to the 2003 AQMP.

2003 AQMP

The 2003 AQMP is a comprehensive final Plan designed to achieve federal ambient air quality standards required by the federal Clean Air Act for the South Coast Air Basin (Basin) and those portions of the Salton Sea Air Basin that are under the AQMD's jurisdiction (namely the Coachella Valley). This revision began with the remaining control strategies in the 1997/1999 State Implementation Draft Plan (SIP), then expanded to new strategies based on current technology assessments. These new control strategies continue to focus on reducing emissions from NOx and VOC—ozone precursors—as well as particulate matter (PM).

The focus of the 2003 AQMP is to demonstrate attainment with federal and state standards for PM10 by 2006 and for ozone by 2010 as well as continued progress towards federal and state 8-hour ozone and PM2.5 standards. The 2003 AQMP combines a traditional command-and-control approach facilitated by market incentive programs and advanced technology to be implemented by 2010. Previous long term measures from the 1997 AQMP have been redrafted into short term measures with specified SIP reduction requirements. Short- and long-term control strategies are proposed and will be implemented by the AQMD, local and regional governments, the California Air Resources Board (ARB), and the U.S. Environmental Protection Agency (EPA). The short-term strategy is made up of control measures that rely on known technology and are proposed to be implemented between 2004 and 2010. While implementation of these measures provides considerable improvements in air quality, further emission reductions are needed to ultimately achieve the ambient air quality standards. Therefore, the final Plan also proposes several long-term measures to be implemented between 2005 and 2010. Some of these measures rely on the advancement of technologies that are currently unavailable for commercial use but are "on the horizon" of development. Others, such as the retirement of old vehicles and in-use engine retrofit technology, would require funding to make them more plausible.

Furthermore, the AQMD has proposed to expand its regulatory program to mobile sources, in some cases, pending additional legal authority. These proposed mobile source measures include a mitigation fee type program for federally mandated sources (e.g., trains, planes, and trucks), an emission fee program for port-related vehicles, and regulations for in-use off-road vehicles. These measures would be implemented between 2008 and 2010.

The implementation of short- and long-term measures will produce both direct and secondary positive and adverse impacts on the community and economy of the 19 sub-county regions. Direct impacts include costs such as expenditures on pollution control equipment, transportation infrastructure, and reformulated products. Direct impacts also include benefits such as decreased medical costs due to better air quality and increased crop yields. Secondary impacts are the spillover impacts of direct costs and benefits as a result of interactions between industries and consumers in the 19 sub-county regions.

LEGAL REQUIREMENTS

As part of the 1989 AQMP approval, the AQMD Governing Board passed a resolution that called for AQMD staff to prepare an economic analysis of emission reduction rules proposed for adoption or amendment. Elements to be included in the analysis include identification of affected industries, cost effectiveness of control, and public health benefits.

In addition, Health and Safety Code Section 40440.8, which took effect on January 1, 1991, requires a socioeconomic analysis of each AQMD rule that has significant emission reduction potential. In addition to the elements required under the AQMD's resolution, Section 40440.8 requires the AQMD to estimate employment impacts and to perform socioeconomic analyses of the project alternatives developed pursuant to the California Environmental Quality Act (CEQA).

Health and Safety Code Section 40728.5 requires that the Governing Board actively consider any socioeconomic impacts in its rule adoption proceedings. Health and Safety Code Section 39616 requires the AQMD to ensure that any market incentive strategies it adopts result in lower or equivalent overall costs and job impacts, (i.e., no significant shift from high-paying to low-paying jobs), when compared with command-and-control regulations. Health and Safety Code Section 40920.6 (Assembly Bill 456), which became effective on January 1, 1996, requires that incremental cost effectiveness (difference in costs divided by difference in emission reductions) be performed whenever more than one control option is feasible to meet control requirements.

None of these requirements apply to the preparation of the AQMP. However, the AQMD has elected to perform a socioeconomic analysis of the final Plan in order to further inform public discussions of the final Plan.

Current Socioeconomic Analysis Program

The AQMD continually seeks to improve its analysis of socioeconomic impacts by expanding its methods and tools. Over the years, the AQMD's socioeconomic analyses have diversified and evolved as shown in Figure 1-1. The AQMD relies on both quantitative and qualitative analyses, describes impacts in absolute and relative terms, and has continually refined its analysis to a more detailed level. In addition, the AQMD is beginning to use facility-based and sub-industry data to better identify the underlying socioeconomic characteristics of various sizes of affected industries historically. Such analysis becomes an important analytic tool in situations where proposed regulations disproportionately impact small or minority owned businesses.

The Massachusetts Institute of Technology (MIT) conducted an audit of the AQMD's socioeconomic impact analysis program (Polenske et al., 1992). This audit found that the

Figure 1-1
Evolution of Socioeconomic Analysis

1. Cost Effectiveness
2. Affected Sources

Pre-1989

1. Cost Effectiveness
2. Affected Sources
3. Affected Industries
4. Range of Control cost
5. Public Health Benefit

1989

1. Cost Effectiveness
2. Affected Sources
3. Affected Industries
4. Range of Control Cost
5. Public Health Benefit
6. Job & Other Socio Economic Impacts of CEQA Alternatives

1990-1991

1. Cost Effectiveness
2. Affected Sources
3. Affected Industries
4. Range of Control Cost
5. Public Health Benefit
6. Job & Other Economic impacts of CEQA Alternatives
7. High- vs Low- paying Job Impacts
8. CPI Impacts by Income Group
9. Relative & Absolute Impacts

1992

1. Cost Effectiveness
2. Affected Sources
3. Affected Industries
4. Range of Control Cost
5. Public Health Benefit
6. Job & Other Economic impacts of CEQA Alternatives
7. High- vs Low- paying Job Impacts
8. CPI Impacts by Income Group
9. Relative & Absolute Impacts
10. Individual Industry Studies
11. Cumulative Impacts of Rules
12. Impacts on 3- to 4- digit SIC
13. Sensitivity Test of Key Assumptions
14. Quantification of More Health Effects
15. Refined Visibility Benefit
16. Cost & Benefit Impacts for Sub-counties

1993-1996

1. Cost Effectiveness
2. Affected Sources
3. Affected Industries
4. Range of Control Cost
5. Public Health Benefit
6. Job & Other Economic Impacts of CEQA Alternatives
7. High- vs Low- paying Job Impacts
8. CPI Impacts by Income Group
9. Relative & Absolute Impacts
10. Individual Industry Studies
11. Cumulative Impacts of Rules
12. Impacts on 3- to 4-digit SIC
13. Sensitivity Test of Key Assumptions
14. Quantification of More Health Effects
15. Refined Visibility Benefit
16. Cost & Benefit Impacts for Sub-counties
17. New Visibility Study
18. Facility-based Analysis
19. Job & Other Economic Impacts for Sub-counties

1997-2003

AQMD surpassed most other agencies in analytical methods. The audit did, however, recommend that the AQMD use alternative approaches and work with the regulated community and socioeconomic experts to refine its socioeconomic assessments. The Scientific, Technical and Modeling Peer Review Advisory Group (STMPRAG), the Ethnic Community Advisory Group (ECAG), and the Local Government and Small Business Assistance Advisory Group (LGSBAAG) have been involved in providing inputs and refinements to the socioeconomic assessments. STMPRAG is composed of leading experts in the socioeconomic and air quality modeling fields, representatives from the regulated community, and participants from public interest groups. ECAG consists of representatives from community groups, small businesses, and grass roots organizations who work extensively with their communities. LGSBAAG is made up of representatives from local governments and small businesses.

In 1998, the AQMD co-funded a visibility study with the most recent property sales data and census data for the four county area (Beron et al., 2001). Results indicated that a strong relationship existed between the marginal willingness to pay for improved visibility (price of visibility) and educational level and household net income.

Towards the goal of expanding its analysis tools, in 2000, the AQMD commissioned BBC Research and Consulting to examine approaches to assessing impacts of proposed regulations on a spectrum of facilities and to evaluating impacts of rules after their adoption. The study results indicated the need to employ a variety of external data sources, construct internal time series data, and explore data sharing opportunities with other governmental agencies.

In preparation for work for the 2003 AQMP, the AQMD has consulted STMPRAG, ECAG, and LGSBAAG to discuss possible and future refinements to data collection, modeling, and socioeconomic processes. Such consultation will continue before the next AQMP for strengthening data sharing between air quality, socioeconomic, and land use models.

2003 AQMP SOCIOECONOMIC ISSUES

In addition to covering all the topics listed under the legal mandates above, this assessment will address the following issues and provide the best estimates of:

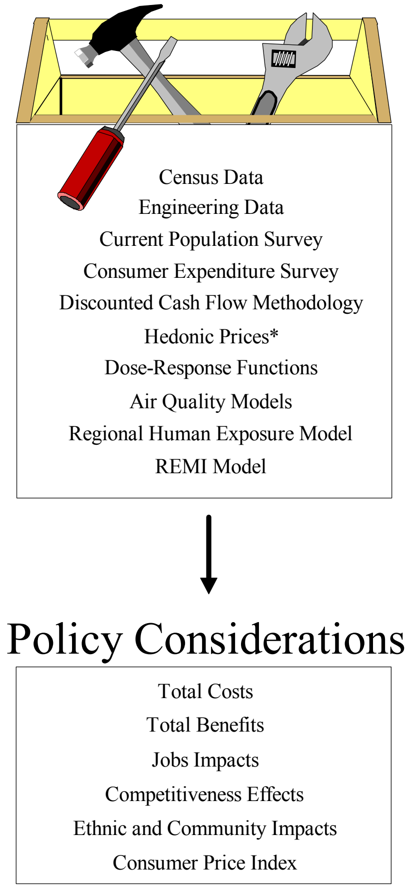
- Benefits of the 2003 AQMP;
- Total implementation cost of the 2003 AQMP;
- Cost of the 2003 AQMP as compared to the benefits;
- Effect of quantifiable measures and benefits of the final Plan will have on employment;
- Potential impacts on sub-county areas and socioeconomic groups;
- Effect the final Plan will have on industrial competitiveness;
- Potential economic effects of the alternatives to the 2003 AQMP; and
- Key areas of uncertainty in this assessment.

ASSESSMENT METHODOLOGY

To assess the socioeconomic impacts of the draft final 2003 Plan, the AQMD has relied on a variety of data sources, methods, and tools (Figure 1-2). The analysis is divided into a number of segments whose interrelationship is shown in Figure 1-3. The analysis is performed at the sub-county level by grouping contiguous census tracts that have similar political, geographical, and social characteristics. Los Angeles County is sub-divided into 11 regions, Orange County four regions, and Riverside and San Bernardino Counties two of each.

FIGURE 1-2

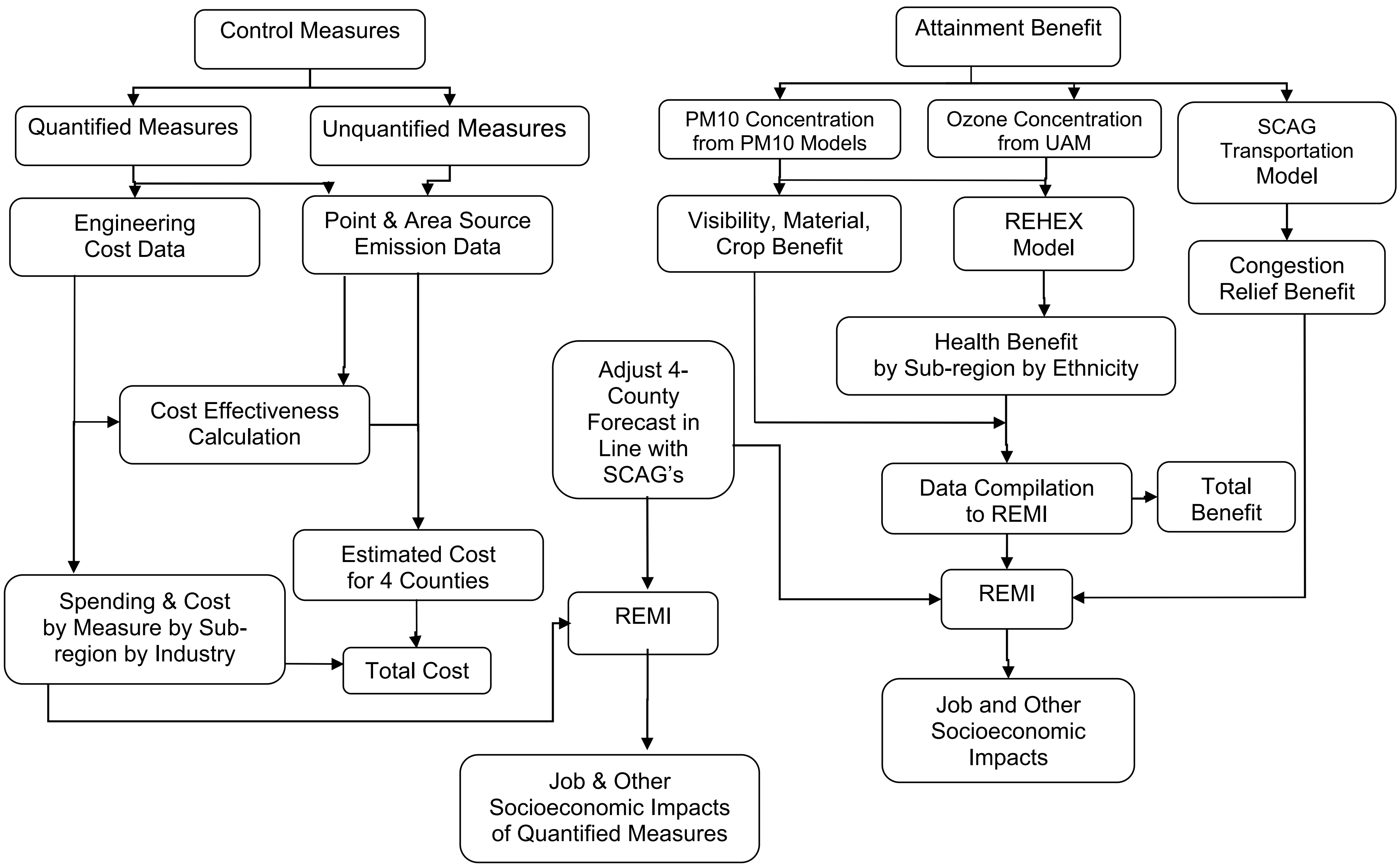
Assessment Tool Kit



*See Glossary

The analysis period is from 2002 to 2020. This is to accommodate some transportation control measures that have been in place since 2002. Second, impacts of control measures will continue years after they are implemented. For example, there are a number of measures that will be implemented close to 2010. Some transportation measures will not come into the system until 2020; however, a portion of funds has been earmarked for their implementation.

Figure 1-3
AQMP Socioeconomic Analysis



Benefit Analysis

A two-step process is utilized to estimate the benefits expected from attaining the federal 1-hour ozone and PM10 and state visibility standards. The first step involves translating the improvements in air quality expected to result from the Plan into dollar values. The benefit categories for which there are quantified relationships with air quality include crop yields, improved human health, the public's willingness to pay for improved visibility, reduced damage to building materials, and reduced vehicle miles and vehicle hours traveled. Established concentration-response relationships and air quality data from different air quality models are used to assess the benefits. The second step involves qualitatively describing the remaining types of benefits that would result from implementing the Plan, but for which monetary benefit estimates are unavailable.

Cost Analysis

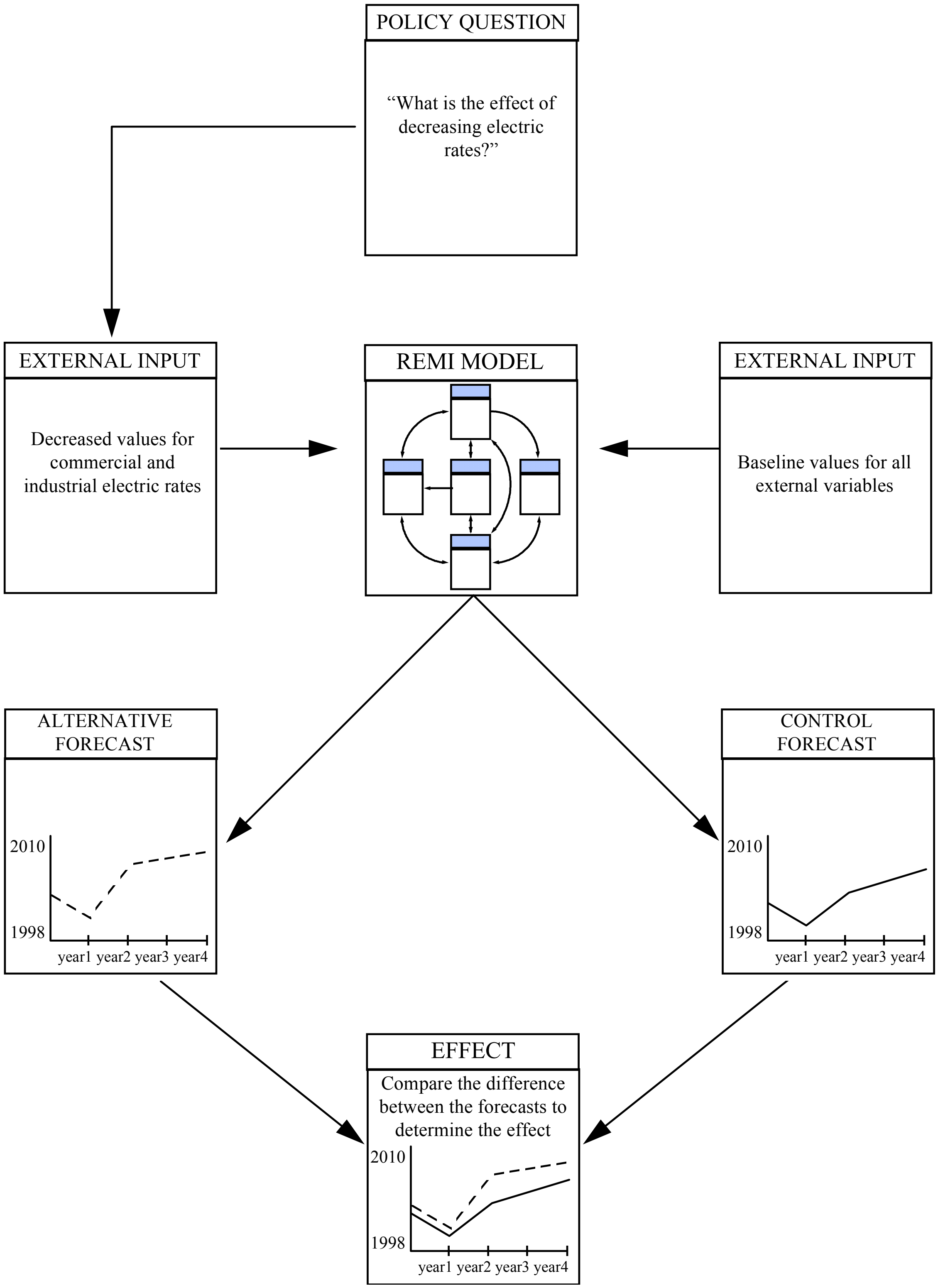
A two-step process is also employed to estimate the costs of the Plan. The first step involves the quantification of the final Plan's impact based on those feasible measures for which cost estimates can be developed at this time. The discounted cash flow method is used to estimate the cost per ton of pollutant reduced for each control measure. The total cost of each control measure is also calculated. Based on the proportions of emission reductions, the total cost of each control measure is allocated to each sub-county region and SIC (Standard Industrial Classification) code. For stationary sources, facility emission reductions are aggregated by sub-region and SIC code according to the location of facilities. For area and mobile sources, emission reductions are assigned to air quality modeling grids. These emission reductions are then aggregated to 19 sub-regions according to the correspondence between grid cells and sub-regions. Population at census tracts from the 2000 census is used to split a grid that may be divided into more than one sub-region.

The second step involves the projection of control costs for those remaining long-term measures in the final Plan. In this second step the average cost-effectiveness for quantified control measures is used as a surrogate cost for unquantified measures. That methodology is likely to over-predict costs if one considers the likelihood that costs will decline as technology advances over the years. However, given the fact that only 30 percent of emission reductions can be quantified, this methodology could under-predict the cost of last few tons of emission reductions in the black box (the remaining 70 percent of emission reductions) needed for attainment. A sensitivity analysis is also provided to address this uncertainty.

Job and Other Socioeconomic Impact Analysis

To estimate job impacts and other socioeconomic impacts that may result from the quantifiable measures and clean air benefits, the REMI (Regional Economic Models, Inc.) 19-region 53-sector model is utilized. The REMI model incorporates state-of-the-art modeling techniques and the most recent economic data. The MIT report conducted on the AQMD's socioeconomic assessments found that the REMI model is "technically sound." Figure 1-4 shows an example of how the REMI model can be used to assess the socioeconomic impact of a policy. Both the cost and benefit impacts are developed outside of the REMI model and are used as inputs to the REMI model.

Figure 1-4
Use of the REMI Model



The REMI model cannot be employed to assess the impacts of the black box due to the lack of information on affected sources and control technology. Because of the relatively large size of the black box, the REMI model is used separately for the quantifiable control measures and clean air benefits. The assessment results from these two categories cannot be added because costs are associated with only 30 percent of emission reductions and clean air benefits are based on the air quality modeling results that used all the emission reductions for attainment demonstration.

To assess the impacts on socioeconomic groups, the impacts on product prices from the REMI model are overlaid on consumption patterns of various income groups to examine the changes in consumer price indexes of these income groups. The data on consumption patterns are from the Bureau of Labor Statistics' Consumer Expenditure Survey. Based on an extensive literature review and survey data on job displacement and re-employment rates of various ethnic groups, the ethnic distribution of the workforce in various industries is adjusted to account for differences in displacement by ethnic group.

To assess the impacts on competitiveness of the four-county area, the following were considered: the region's share of national jobs in those industries whose products are also sold in the national market, the impacts of the final Plan on product prices and profits by industry, and the changes in imports and exports as a result of implementing the final Plan's measures. These factors are selected based on a review of effects of past public policies on a region's competitiveness.

CHAPTER 2

POPULATION AND ECONOMY OF THE FOUR-COUNTY REGION

INTRODUCTION

Los Angeles, Orange, Riverside, and San Bernardino counties collectively constitute one of the largest regional economies in the United States. In 2003, the area's gross regional product (GRP) was $375.5 billion (1992 dollars), which was six percent of the nation's gross domestic product (REMI, 1999). These counties contained 16.1 million people in 2001, which was equivalent to 46 percent of California's total population (California Department of Finance, 2002) or six percent of the estimated U.S. population (U.S. Census Bureau, 2001). In addition, there were 6.5 million wage and salary workers in the four-county area in 2001, a 44 percent share of the state's total wage and salary workforce (California Department of Finance, 2002).

POPULATION

The population of the four-county area is expected to grow from its 1997 level of 14.9 million to 18 million in 2010 and 21.1 million in 2025 (SCAG, 2002b). This represents an annual population growth rate of 1.25 percent over the 2001 - 2025 period. Between 2010 and 2025 annual population growth will decrease slightly to an average of 1.1 percent.

According to the 2000 census, the 15.6 million residents in the four-county area had the following racial and ethnic distribution: 38 percent were White, 8 percent were African American, 40 percent were Hispanic, 11 percent were Asian or Pacific Islander, and 3 percent were of other races or multiple race. Los Angeles County was the most racially and ethnically diverse county in the region with 31 percent Whites and 45 percent Hispanics. Los Angeles and Orange counties had the highest percentage of Asians among the four counties and Orange and Riverside counties had the highest percentage of Whites. In all four counties, Whites and Hispanics were the two largest ethnic groups. Figure 2-1 shows the ethnic distribution of the population by county.

FOUR-COUNTY ECONOMY

The four-county economy is the tenth largest in the world, and is well diversified. The region has good growth prospects in foreign trade, professional services, tourism and entertainment, and high tech manufacturing (CCSCE, 2002a). The four-county region is well situated in proximity to Mexico and the Asian markets and is likely to continue as a leader in the entertainment industry. The four-county region has the nation’s largest diversified manufacturing sector, which is transitioning away from heavy industry to design, fashion, and craft skills, driven by smaller, entrepreneurial firms. There is also an increased concentration of activities in science, biotech, and information technology.

From 1997 to 2000, job growth in the four-county region (1.2 percent) outpaced the nation (0.2 percent). In 2001 California began to experience an economic slowdown along with the nation. The four-county region experienced a less severe economic downturn than the nation or California, where job losses were most heavily concentrated in the San Francisco metropolitan area and Silicon Valley. Between 2001 and 2003, over 36,500 jobs were lost in the four-county region (CSSCE, 2003b). Los Angeles and Orange counties experienced job losses while the Inland Empire had a 5 percent job growth rate.

The region's ports and airports also had their trade volumes drop in 2001 during the current downturn. In 2001 there were 69 billion in exports and 143 billion in imports, representing a 6.3 percent decrease in exports and 9 percent decrease in imports from 2001.

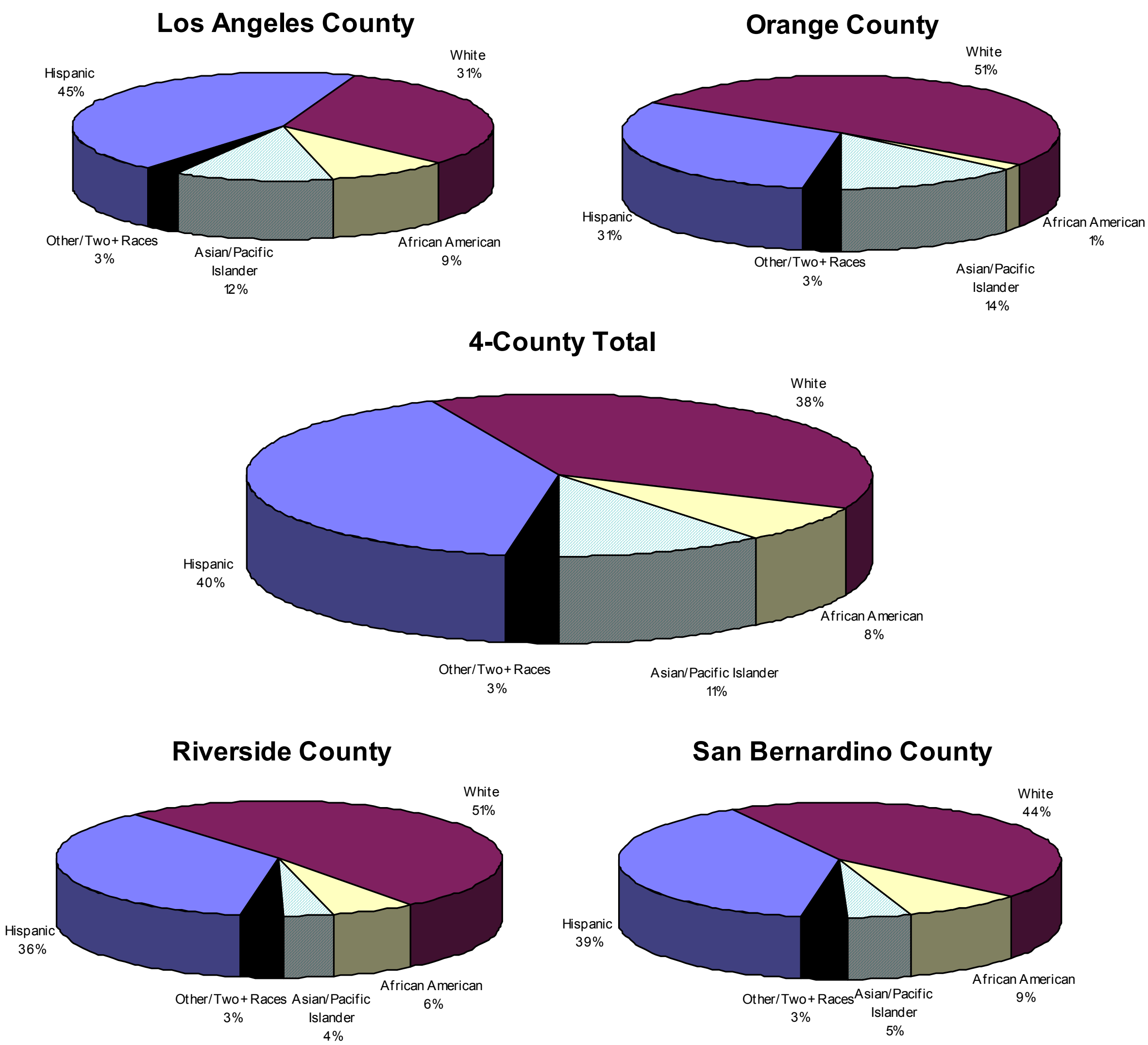


FIGURE 2-1

Population by Race and Ethnicity

Future Growth

Between 1997 and 2025, the four-county region is projected to increase by 2.81 million jobs or an annual growth rate of 1.3 percent (SCAG, 2002a). Total employment in Los Angeles County is projected to increase by 1 million jobs or an 0.8 percent annual growth rate while Orange County is projected to increase by 0.7 million jobs or a 2.2 percent annual growth rate. Similar to population growth, total employment in Riverside County is projected to increase by 0.55 million jobs or a 4.5 percent annual growth rate and San Bernardino County is projected to increase by 0.56 million jobs or a 3.8 percent annual growth rate.

Projections by the REMI (Regional Economic Models, Inc.) model indicate that from 1997 through 2020, almost 3 million new jobs are predicted for the four-county area, as shown in Figure 2-2 below. The REMI model's forecast has been adjusted to ensure consistency with SCAG's (Appendix C). This represents an estimated annual growth of approximately 1.4 percent.

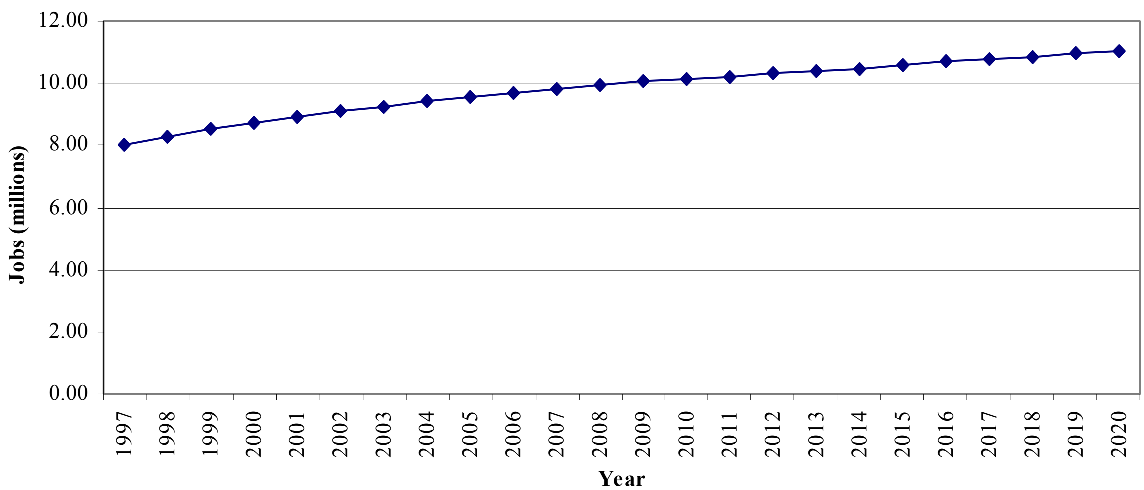


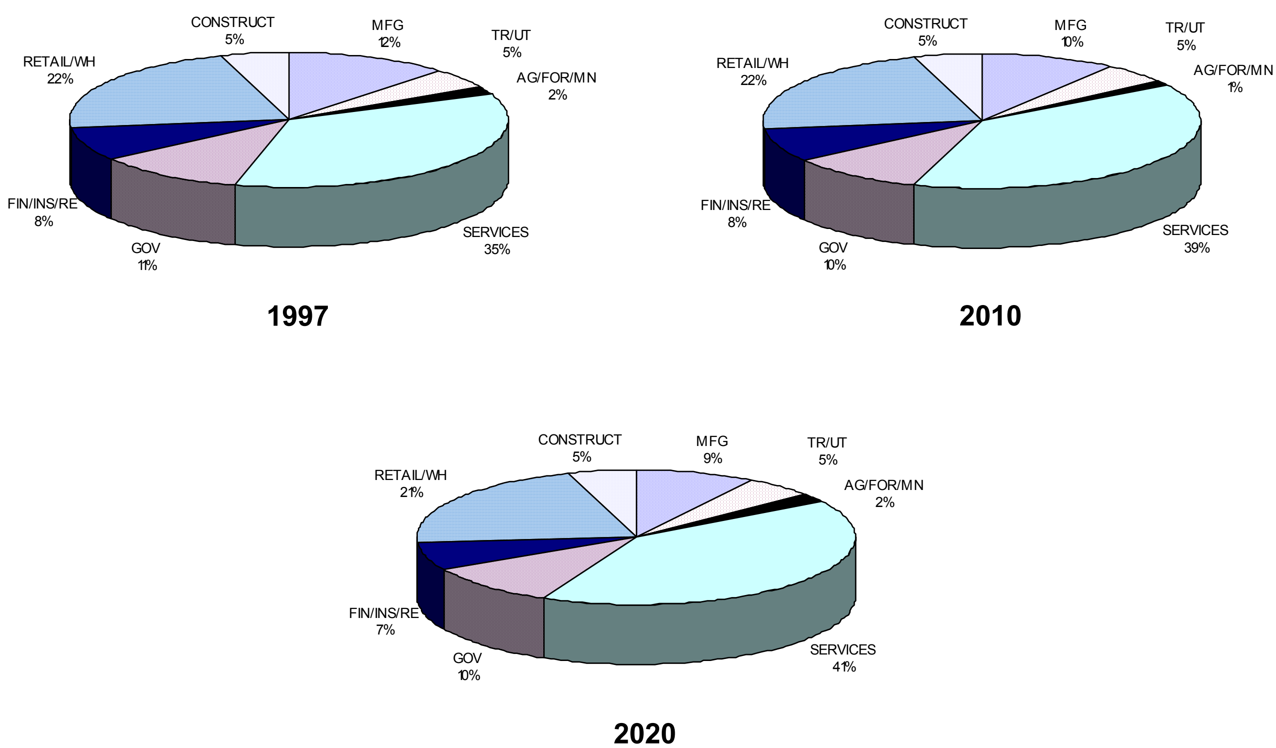
Figure 2-2

Projected Employment Growth in the Four-County Area

Projections for the 1997 AQMP predicted an increase of three million jobs for the four-county region between 1993 and 2010. This represents an annual growth rate of 2 percent, which was higher than the 1.79 percent rate of growth between 1993 and 2010 for the 2003 AQMP.

Figure 2-3 shows historical (1997) and projected employment in key sectors for 2010 and 2020. These sectors are represented by Standard Industrial Classification (SIC) codes. Employment in the manufacturing sector (SIC 20-39) is projected to decrease at an annual rate of 0.18 percent between 1997 and 2020. Employment in the service sector (SIC 70-89) is expected to grow by 2.7 percent per year over the entire period (1997-2020).

The service sector and the retail and wholesale trade sector (SIC 50-59) combined constituted over 57 percent of the region's employment in 1997. The four-county economy, which is composed of a large non-manufacturing sector, is becoming more service-based. As shown in Figure 2-3, the service sector is projected to increase its share of the region's employment from 35 percent in 1997 to 41 percent in 2020. The share of employment in retail and wholesale trade is expected to decrease slightly from 22 percent to 21 percent between 1997 and 2020. The government sector's (SIC 91-97) share of employment is projected to decrease slightly from 11 percent in 1997 to 10 percent in 2020. The manufacturing, transportation (SIC 41-47), and utilities (SIC 49) sectors' share of employment is projected to decline from its 17 percent share in 1997 to a 14 percent share in 2020.



AG/FOR/MN:	Agriculture, Forestry/Mining
CONSTRUCT:	Construction
FIN/INS/RE:	Finance, Insurance, Real Estate
MFG/TR/UT:	Manufacturing, Transportation, Utilities
RETAIL/WH:	Retail, Wholesale

FIGURE 2-3
Projected Employment by Sector in the Four-County Economy

The 8 percent share of employment of the finance, insurance, and real estate sector (SIC 60-67) in 1997 is expected to decrease slightly to 7 percent in 2020. The four-county area's gross regional product (GRP) is projected to increase from its 1997 level of $293 billion (in 1992 dollars) to $497 billion in 2020, which represents a 2.3 percent annual growth rate.

Historical Patterns

After recovery from the economic recession of 1990-1993, the region's total employment grew from 5.6 million employees in 1993 to 6.5 million employees in 2000, slightly faster than the nation (EDD, 2003). This is based on an analysis of 1990-2002 historical labor force data for wage and salary workers compiled by California's Employment Development Department (EDD). Beginning in 2002, EDD's sectoral designation is only available by the North American Industrial Classification System (NAICS) codes. Historical employment data by SIC will no longer be available beyond 2001. However, EDD has converted historical employment series from SIC to NAICS for the period of 1990 to 2001.

Los Angeles County experienced a sizeable gain in jobs—324,700 jobs from 1993 to 2002. Orange County gained 288,000 jobs between 1993 and 2002. San Bernardino and Riverside counties experienced a tremendous amount of growth with 322,900 new jobs between 1993 and 2002. Historical employment by county is shown below in Figure 2-4.

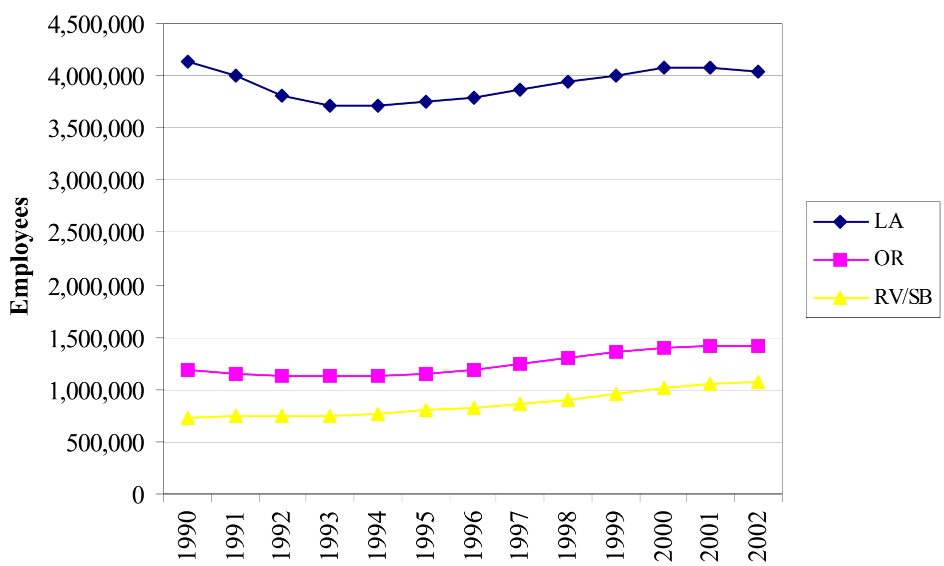


FIGURE 2-4

Historical Employment by County

The trend in Figure 2-5 shows the decline of the manufacturing sector (NAICS 31-33) after 1998 and the continual rise of the healthcare and social assistance sector (NAICS 62) which is referred to as Health in Figure 2-5. Between 1998 and 2002, the manufacturing sector lost 125,400 jobs in the four-county region. After the recession in 1994, the wholesale and retail trade sectors (NAICS 42, 44-45) gained 148,800 jobs between 1994 and 2002, making them two of the region's strongest sectors (these two sectors are combined and referred to as Wh/Retail in Figure 2-5). The professional and technical services sector (NAICS 54) had an even more dramatic upsurge in activity, gaining 204,300 jobs between 1993 and 2002 (this sector is referred to as Prof Srvs in Figure 2-5). The arts, entertainment and recreation sector (NAICS 71) and the accommodation and food services sector (NAICS 72) showed more moderate growth with an increase of 102,700 jobs between 1995 and 2002 (these two sectors are combined and referred to as Leisure in Figure 2-5). A similar moderate growth pattern is also exhibited by the healthcare and social assistance sector (NAICS 62) with an additional 62,100 jobs between 1998 and 2002. The finance and insurance sector (NAICS 52) declined throughout the 1990s and has only begun to experience a small amount of job growth, with an increase of 27,300 jobs between 2000 and 2002 (this sector is referred to as Finance in Figure 2-5). The information sector (NAICS 51) that includes the majority of the motion picture as well as printing and publishing industries experienced a gradual spurt of growth from 1994 to 2000, gaining an additional 78,500 jobs before losing 38,200 jobs from 2000 to 2002 (this sector is referred to as Info in Figure 2-5).

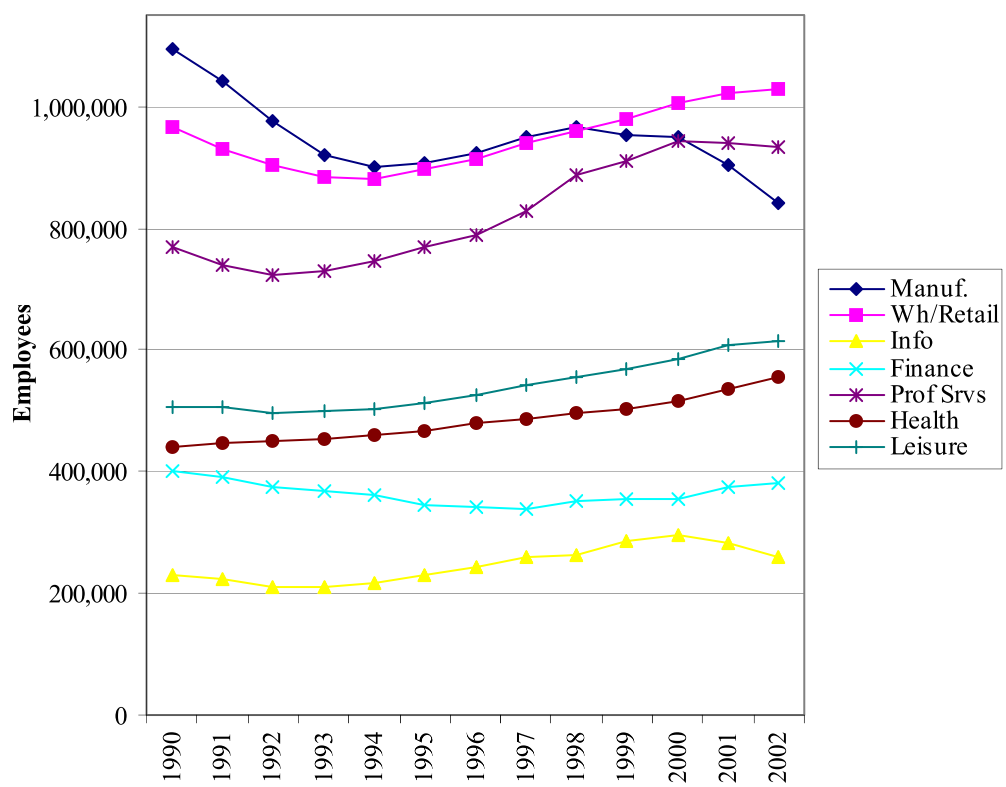


FIGURE 2-5

Historical Employment by Industry

Ethnic Distribution of the Workforce

Data from the 1990 Census also provides an insight into the ethnic composition of the workforce by major industry and by occupational category. Data from the 2000 Census which would have provided an update to the 1990 census has not been released to the public yet.[1] Table 2-1 shows the workforce's ethnic composition in the four-county area in 2000 for 11 major economic sectors. Knowing the ethnic makeup of the workforce in various industries is important in assessing the potential impact of the 2003 AQMP on ethnic groups. Sectors with the highest proportion of Whites were mining; finance, insurance, and real estate; and services. African Americans were represented more frequently in the government; transportation, communications, and utilities; and service sectors. The sectors where Asians and Pacific Islanders were represented in the highest proportions were finance, insurance, and real estate; and wholesale and retail trade. Hispanics were found in the highest proportions among the agricultural, non-durable goods manufacturing, and construction sectors.

TABLE 2-1

Ethnic Composition of the Four-County Workforce
by Major Sector

	Percentage					
Industry	White	African American	Asian	Hispanic	Other	Employment (in thousands)
Agriculture	30.6	2.5	6.3	60.3	0.4	106
Mining	66.8	7.2	3.6	21.6	0.9	10
Construction	56.5	3.5	4.2	35.2	0.7	432
Nondurable Manufacturing	37.2	4.0	9.1	49.2	0.5	413
Durable Manufacturing	49.5	5.4	9.4	35.1	0.6	854
Transportation & Public Utilities	54.1	12.7	8.2	24.0	0.9	426
Wholesale Trade	55.5	4.3	10.9	28.7	0.6	320
Retail Trade	51.0	5.0	10.8	32.6	0.6	1017
Finance, Insur., Real Est.	65.6	7.1	11.0	15.9	0.5	508
Services	58.2	8.3	9.4	23.5	0.6	2118
Government	56.4	16.0	7.8	19.0	0.8	210
Total	54.1	6.9	9.3	29.1	0.6	6414

GEOGRAPHIC VARIATION IN SOCIOECONOMIC TREND

Based on census tract boundaries with consideration of topographical features and city boundaries, the four-county area was divided into nineteen sub-regions. The counties of

[1] 2000 Census PUMS 1 percent data was scheduled to be released in April 2003 and hence is unavailable for this analysis.

Riverside and San Bernardino were divided into two sub-regions each: the more urbanized western portions and the more sparsely populated eastern areas. Los Angeles County was divided into eleven sub-regions and Orange County was divided into four sub-regions. Figures 2-6 and 2-7 shows the ethnic distribution of population in 1990 and 2000 in each of these sub-regions, respectively.

Socioeconomic characteristics on the sub-regions were compiled using 1990 and 2000 Census data. These data were aggregated to the sub-region level by apportioning census tracts to the appropriate sub-region. Spatial allocation of census tracts were assigned to sub-regions using ArcGIS. The nineteen sub-regions showed considerable variation as measured by several socioeconomic indices (Table 2-2). The less populated sub-regions of Riverside and San Bernardino Counties had significant increases in population between 1990 and 2000. The relative presence of minorities in each area ranged from a low of 31 percent in the southern part of Orange County to 98 percent in the south central area of Los Angeles County according to the 2000 census. Minority population increased in all sub-regions between 1990 and 2000 but increased most dramatically in the less populated sub-regions of Riverside and San Bernardino Counties. The percentages of youth and elderly are fairly uniform throughout the sub-regions with the exception of a slightly lower percentage of youth in the western area of Los Angeles County. The percentage of youth increased in all sub-regions between 1990 and 2000 with the greatest increase in the beach and northern sub-regions of Los Angeles County. The northern and western sub-regions of Orange County had the greatest increase in elderly population. The poverty rates ranged from a low of 6 percent in the southern part of Orange County to 33 percent in the south central area of Los Angeles County according to the 2000 census. The poverty rate increased in all sub-regions between 1990 and 2000, increasing the most in the northern sub-region of Los Angeles County and less populated sub-region of San Bernardino County.

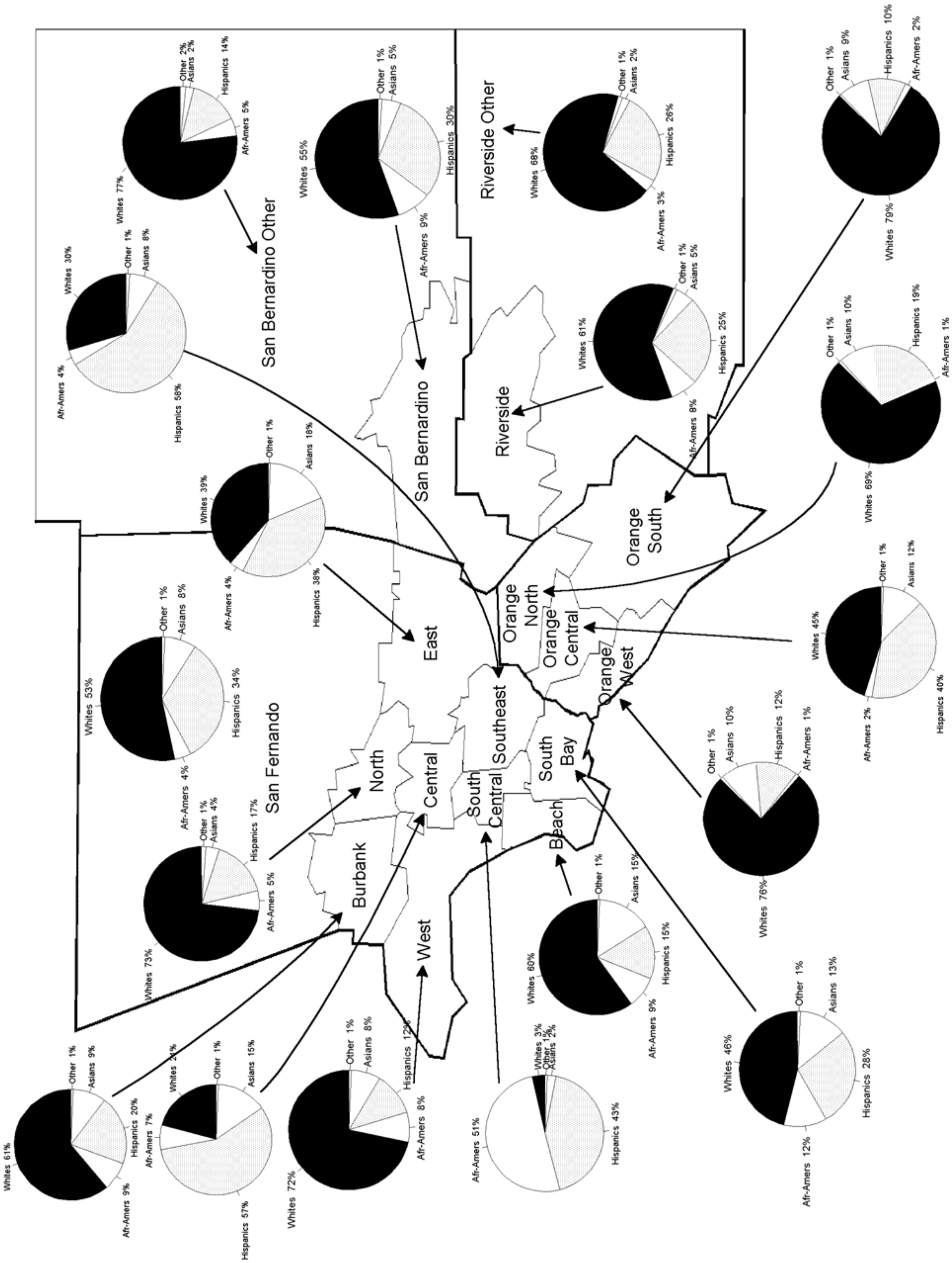


FIGURE 2-6
1990 Census: Ethnic Distribution of Population

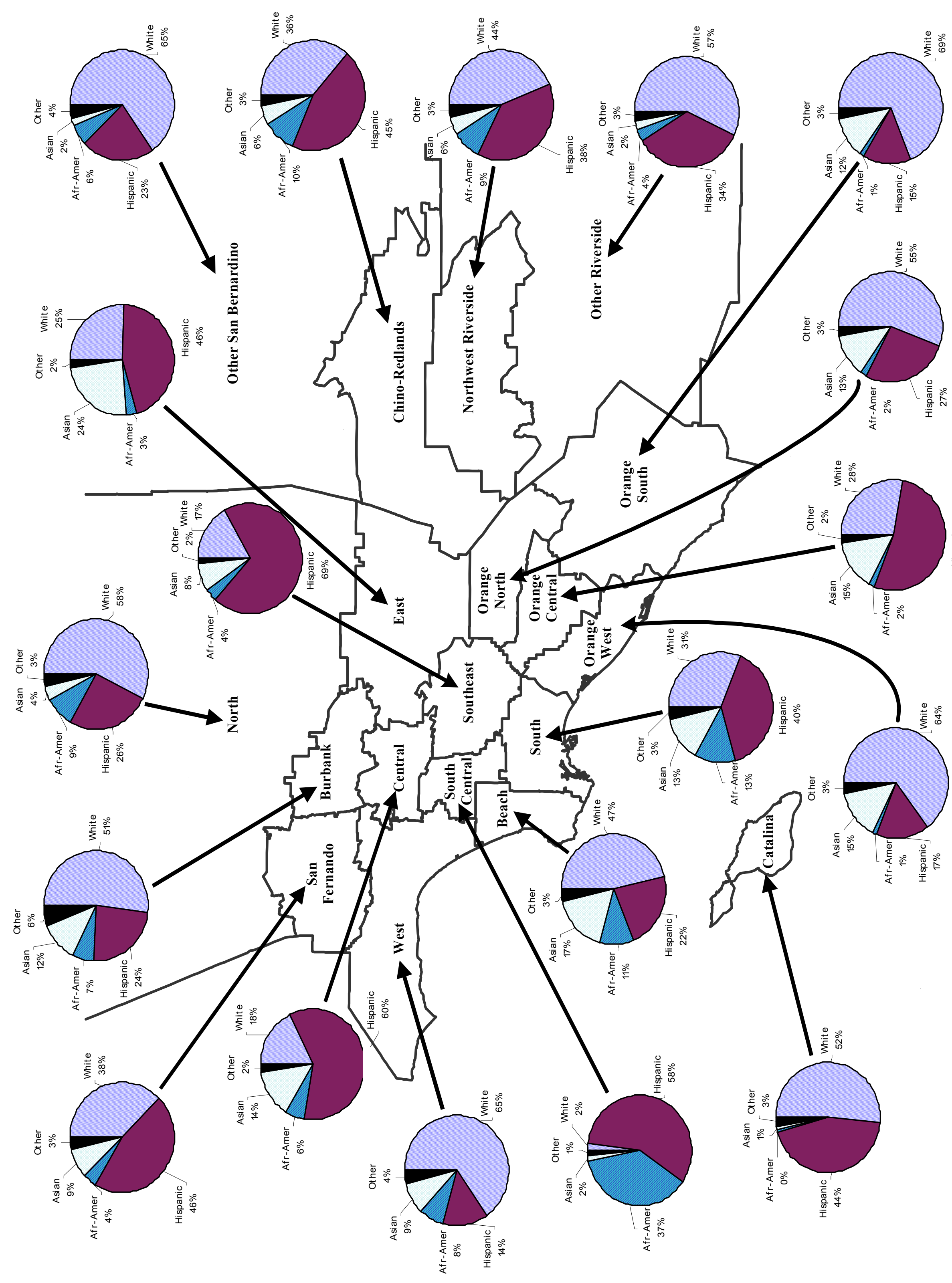


FIGURE 2-7
2000 Census: Ethnic Distribution of Population

TABLE 2-2

Comparison of Socioeconomic Characteristics of County Sub-areas in 1990 and 2000

Subarea	Population (thousands)		Percent (%)							
			Minority[1]		Poverty[2]		Youth[3]		Elderly[4]	
	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
LA Burbank	541	570	39%	48%	12%	13%	22%	24%	13%	13%
LA San Fernando	1,107	1,240	47%	62%	11%	16%	25%	28%	10%	10%
LA West	791	825	28%	35%	9%	11%	15%	17%	14%	13%
LA Central	1,212	1,230	79%	82%	23%	27%	26%	26%	9%	9%
LA South Central	945	979	97%	98%	29%	33%	34%	36%	8%	7%
LA South	800	856	54%	69%	14%	19%	26%	29%	10%	10%
LA East	1,473	1,576	62%	75%	11%	14%	28%	28%	9%	10%
LA Southeast	1,067	1,170	71%	69%	14%	16%	31%	32%	9%	8%
LA Island	3	4	38%	48%	N.A.[5]	11%	N.A.	30%	N.A.	9%
LA Beach	527	561	40%	53%	7%	10%	21%	25%	10%	11%
LA North	387	509	25%	43%	4%	12%	27%	32%	6%	7%
ORANGE North	352	401	31%	44%	7%	9%	25%	27%	8%	10%
ORANGE Central	869	1,012	55%	72%	13%	16%	27%	31%	8%	8%
ORANGE South	587	785	21%	31%	5%	6%	24%	26%	10%	10%
ORANGE West	602	649	24%	36%	6%	8%	21%	23%	10%	12%
Northwest Riverside	553	668	39%	56%	10%	14%	31%	33%	7%	7%
Other Riverside	603	863	32%	43%	10%	15%	27%	29%	20%	17%
Chino-Redlands	1,049	1,263	55%	64%	12%	16%	31%	33%	8%	7%
Other San Bernardino	357	437	23%	35%	8%	15%	27%	30%	13%	12%
South Coast Air Basin	13,828	15,596	50%	62%	13%	16%	26%	29%	10%	10%

[1]Percentage of Minority is defined as anyone but non-Hispanci White in a single race designation divided by the total population.

[2]Poverty levels vary by family size. For the 1990 Census, the federal poverty level for a family of four is $12,674. For the 2000 Census, the federal poverty level for a family of four is $17,050.

[3]Youth = 18 years old or younger

[4]Elderly = 65 years old or above

[5]N.A. = Not Available

CHAPTER 3

BENEFITS AND COSTS

INTRODUCTION

Public policies are often examined relative to their overall costs and benefits, which provides a general indication of the net economic impact of the policy. Applying that approach to the AQMP requires the full quantification of costs and benefits in dollars. Equipment and materials which are required by control measures are purchased and sold in markets, and their prices can thus be used to measure the costs of implementing control measures. Cost quantification becomes more uncertain when control technologies cannot be specifically identified. This is especially true as cheaper options are deployed and marginal costs are on the rise for the last few tons of emission reductions in order to reach attainment. On the other hand, the possibility of technology advancement and its large scale production due to regulatory requirements may drive down the cost of control.

There is no direct way to measure benefits of clean air because clean air is not a commodity purchased or sold in a market. Placing a monetary value on reduced incidence of illness or loss of life is also difficult and more subjective than determining control equipment costs. This often results in incomplete assessments of benefits, thereby leading to the underestimation of benefits.

BENEFITS

Despite the uncertainty of assigning dollar figures to benefits of attaining the federal 1-hour ozone and PM10 and making progress towards the state visibility standards it is apparent that clean air will result in significant benefits to the four-county region. Partial assessments can be made for the impact of better air quality on crop yields, visibility, materials, morbidity, and mortality. The full assessment of air quality benefits in dollars terms is, however, not possible until advances occur in the epidemiological and economic disciplines, which will then allow monetary estimates to be made for currently unquantifiable areas.

Quantified Benefits

Despite the fact that there are control measures proposed by CARB for NOx and VOC reductions, CARB has not committed in the 2003 AQMP any emission reductions prior to 2010. Implementation of PM10 measures would lead to lower PM10 concentrations beginning in 2005. For this reason, it is assumed that there would be no improvement in ozone before 2010 and in PM10 before 2005. However, air quality would continue to improve due to previously adopted regulations and implementation of many short-term measures prior to 2010. It is further assumed that the 2010 air quality achieved under the 2003 AQMP would prevail in 2020.

Although attainment demonstration is performed with respect to the worst air quality site, the benefit assessment (except for the material benefit) herein is analyzed with respect to the changes in the projected air quality concentrations between the present level of control and the final 2003 AQMP for the benchmark years in each air quality modeling grid (5 kilometer by 5 kilometer). The total average annual quantifiable benefits associated with implementing the draft final 2003 AQMP are projected to be \$6.6 billion, which represents the currently quantifiable benefit of moving beyond today's regulations to the level needed to meet the federal standards. A breakdown of these benefits is shown in Table 3-1. The benefit ranges from $18 million for reduced damage to crops to $2.6 billion for reductions in morbidity and mortality.

TABLE 3-1
Quantifiable Benefits of Draft Final 2003 AQMP
(millions of 1997 dollars)

Benefit	Average Annual
Reduction in Morbidity	$449
Reduction in Mortality	2,130
Increased Crop Yields	18
Visibility Improvement	1,940
Reduced Materials Expenditures	63
Congestion Relief	2,038
Total	$6,639

Health Benefit

It is well-documented that smog can result in short-term and chronic illness. Figure 3-1 illustrates this point. Numerous studies have demonstrated an association between illness and ambient air pollutants. Based on a study by Chestnut and Keefe (1996) and projected air quality data, the quantifiable health benefits of achieving at least the state ozone and PM10 air standards are estimated to be $2.5 billion in 2010. This estimate is based on the quantification of only 20 percent of the identified potential health impact areas (13 out of 66 cubes in Figure 3-2). Thus, it is a very conservative estimate (i.e., underestimation).

FIGURE 3-1
Smog Effects

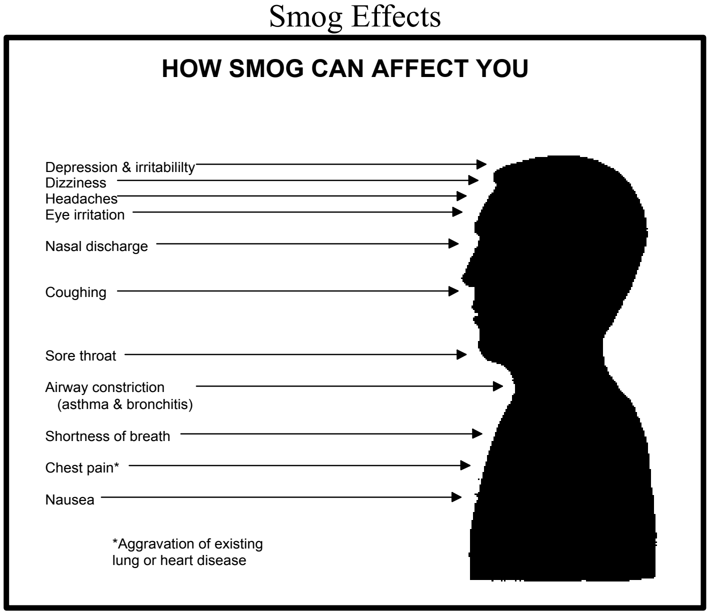
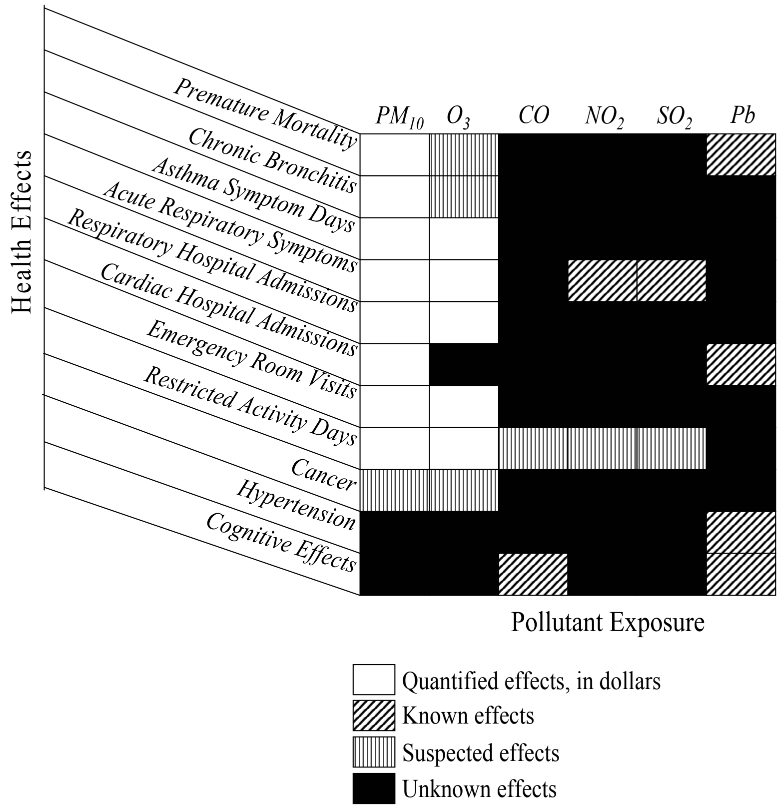


FIGURE 3-2
Health Effects of Criteria Pollutants



Quantification of health benefits requires the establishment of concentration-response functions for various symptoms and translation of health endpoints into dollar values. The latter step is needed in order to monetize known effects. Additional epidemiological studies are needed for unknown and suspected effects before developing concentration-response functions.

The majority of the region's population is exposed to unhealthful air. Ozone can permanently scar lung tissue, cause respiratory irritation and discomfort, and make breathing more difficult during exercise. Children, the elderly, and persons who exercise heavily incur a higher rate of health effects. Assessments were made for the reductions in respiratory hospital admissions, asthma emergency room visits, asthma symptom days, minor restricted activity days, and acute respiratory symptom days (measured in person-days per year) resulting from reductions in daily maximum 1-hour ozone concentration for the benchmark years 2010 and 2020 between the final Plan and the base case where no additional control beyond today's level will be employed.[1]

[1] The exposure in terms of person-days is calculated using the state standard as the threshold for both the base and control cases, respectively. If a grid has ozone (PM10) concentrations under the state standard in both base and control cases, no health benefit is assigned to the grid. If the grid has ozone (PM10) concentrations above the state standard in both base and control cases, the difference in exposure is used as the reduction in the specified health effect. If the grid has ozone (PM10) concentrations above the state standard in the base case and below the state standard in the control case, the exposure in the base case is used. If the grid has ozone concentrations below the state standard in the base case

PM10 may cause effects as extreme as premature death as well as increased respiratory infection, asthma attacks, and other related effects. Groups that are most sensitive to the effects of PM10 are probably children, the elderly, and people with certain respiratory and heart diseases. Assessment are made for reductions in premature deaths and chronic bronchitis resulting from reductions in annual average PM10 concentrations; and reductions in respiratory hospital admissions, cardiac hospital admissions, emergency room visits, asthma symptom days, restricted activity days, and acute respiratory symptom days (measured in person-days per year) resulting from reductions in daily PM10 concentrations for the benchmark years 2006, 2010, and 2020. [2]

Reductions in symptoms are then translated into monetary terms based on the cost of illness (medical costs and work loss) or willingness to pay associated with each symptom.[3] Benefits for interim years are interpolated. Table 3-2 shows the quantifiable health benefit of improved air quality associated with the draft final 2003 AQMP for ozone morbidity and PM10 morbidity and mortality relative to air quality without the draft final Plan. The total health benefit is projected to reach $2.5 billion in 2010. On average, the annual benefit from 2005 to 2020 is approximately $2.6 billion. Please refer to page A-3 of Appendix A for a description of the methodology used to quantify the health benefit.

TABLE 3-2

Quantifiable Health Benefits
(millions of 1997 dollars)

Category	2010	2020	Average Annual (2005-2020)
Ozone Morbidity	$44	$116	$80
PM10 Morbidity	387	562	369
PM10 Mortality	2,048	3,517	2,130
Total	$2,479	$4,195	$2,579

Agricultural Benefit

Ozone has been recognized to damage vegetation and many crops more than all other pollutants combined. Since the early 1970s, numerous studies have shown that ozone inhibits crop productivity and results in potential reductions in crop yield.

Based on the published ozone damage functions (Olszyk and Thompson, 1989; Randall and Soret, 1998) for many crops (i.e., grapes, oranges, lemons, tangerines, beans, field corn, sweet corn, melons, watermelon, potatoes, spinach, tomatoes, cotton, alfalfa, wheat, and avocados) and the gridded air quality data, the cash value of increased crop yield from implementing 2003 AQMP was estimated for each air quality grid.

and above the state standard in the control case, the exposure in the control case is served as the increase in the specified health effect (a disbenefit).

[2] Ibid.

[3] A range of willingness to pay values (low, central and high) for each symptom was examined by Chesnut and Keefe (1996). The central value is used in the analysis herein.

The location of the agricultural crops and acreage were obtained by spatially joining the Public Land Survey (PLS) grid system (1 mile by 1 mile), which covers the township, range, and sections, and information on crop acreage (which refers to the PLS) from the 2001 California Department of Pesticide Regulation (CDPR) for the four county area. The result was then overlaid on top of the air quality modeling grid system (5 kilometer by 5 kilometer). The land area of grids was used to allocate crop acreage of a PLS grid that crosses more than one air quality grid. The 2001 <u>County Crop Report</u> for various counties was used to normalize crop acreage at the air quality grid level to the county total.

Implementation of the draft final 2003 AQMP is projected to increase the yield of 16 crops by \$17.8 million in 2010 and \$18.6 million annually in 2020, respectively. Of the 16 crops assessed, melons, beans, and grapes are the most sensitive to ozone. Table 3-3 shows the annual value of increased yield by county. Cash values for interim years were interpolated based on those for benchmark years.

TABLE 3-3
Cash Value of Increased Crop Yields
(millions of 1997 dollars)

County	2010	2020	Average Annual (2010 to 2020)
Los Angeles	\$0.2	\$0.2	\$0.2
Orange	2.2	2.7	2.5
Riverside	14.1	15.2	14.6
San Bernardino	1.3	0.5	0.9
Total	\$17.8	\$18.6	\$18.2

<u>Visibility Aesthetic Benefit</u>

It has been shown that visibility—the ability to see distant vista—has an impact on property values. To examine such relationship, researchers correlated sales prices of owner-occupied single-family homes between 1980 and 1995 with socioeconomic and housing characteristics of these homes and visibility data at the census tract level to arrive at a willingness to pay value for visibility (Beron et al., 2001). The research was performed for the counties of Los Angeles, Orange, Riverside, and San Bernardino. In this research, the marginal willingness to pay for visibility (or price of visibility) was related to the percentage of college degree of people 25 years or older, net income (household income minus housing cost), and visibility (in miles) at each location.[4]

[4] The marginal willingness to pay (MWTP) equation used for this assessment is:

$$MWTP = 9032.42 + 0.09Y + 200.73\,(COLLEGE) - 425.33V$$

Where Y stands for net income, COLLEGE for percentage of college degree, and V for visibility.

The total willingness to pay (TWTP) for a specific reading of visibility is arrived at by integrating the above equation with respect to V:

$$TWTP = 9032.43V + 0.09YV + 200.73\,(COLLEGE)V - (\tfrac{1}{2})\,425.33V^2$$

Using visibility data for the benchmark years 2006, 2010, and 2020 and the projected net income and percentage of college degree population (age 25 and above) at the sub-region level, the average monetary value of visibility improvements per household from the final 2003 AQMP was calculated for each sub-region. These values were then annualized over a 50-year period at the four-percent real interest rate, which was then multiplied by the number of households to arrive at total values of visibility benefits. These totals were further adjusted downward by 55 percent to reflect visibility aesthetics only to avoid the potential aggregation of health and visibility embedded in the willingness to pay (Loehman et al., 1994). Benefits for visibility improvements during non-benchmark years were interpolated based on the benefits for benchmark years.

The average annual visibility aesthetic benefit between 2005 and 2020 is projected to be $1.9 billion. Table 3-4 shows the visibility aesthetic benefit by county. A sensitivity analysis using different functional forms for the marginal willingness to pay equation shows that the average annual visibility benefit can range from $661 million to $4.3 billion.

TABLE 3-4
Visibility Aesthetic Benefit by County
(millions of 1997 dollars)

County	2010	2020	Average Annual (2005-2020)
Los Angeles	$1,142	$1,879	$1,164
Orange	513	704	472
Riverside	218	235	180
San Bernardino	129	184	123
Total	$2,002	$3,002	$1,940

<u>Material Benefit</u>

Research has shown that ozone results in damage to rubber products such as tires (McCarthy et al., 1984). Damages from PM10 to residential and commercial materials include accelerated wear and breakdown of painted wood and stucco surfaces of residential and commercial properties (Murray et al., 1985). In addition, PM10 exposure will lead to additional household cleaning costs (Cummings et al., 1985).

The avoided damage to tires was calculated based on the basinwide peak 1-hour ozone concentration and the total population in each county. The annual average PM10 concentrations at five locations (two in Los Angeles County and 1 in each of the three other counties) were used to calculate the avoided household cleaning and damage to wood and stucco surfaces of residential properties that are projected to grow proportionately with the growth of housing units.[5] The avoided damage to commercial properties was assessed at three percent of that to residential properties. The analysis was performed at the county level for the benchmark years 2006, 2010, and 2020 and interpolated for the interim years. The total avoided damage from all

[5] The household cleaning coefficient was adjusted downward by multiplying the proportion of soiling in the total contingency valuation (0.088).

the sources was allocated to each sub-region according to its proportion of population or housing units within a county.

The total benefit associated with the decrease in costs for repainting stucco and wood surfaces, cleaning, and replacing damaged materials is projected to be $78 million in 2010 and $80 million in 2020. Table 3-5 shows material benefits by county for selected years.

TABLE 3-5
Material Benefit by County
(millions of 1997 dollars)

County	2010	2020	Average Annual (2005-2020)
Los Angeles	$47	$46	$37
Orange	15	15	12
Riverside	9	11	8
San Bernardino	7	9	6
Total	$78	$80	$63

The sum of individuals may not add to total due to rounding.

Traffic Congestion Relief Benefit

The four-county region is the most heavily congested area in the nation due to its urban sprawl and lack of affordable housing (Surface Transportation Policy Project, 2003). An estimated 85 percent of the freeway lane miles in the four-county region are congested, resulting in the loss of fuel, time, and productivity.

Implementation of SCAG transportation on-road control measures will reduce daily vehicle miles traveled (VMT) and daily vehicle hours traveled (VHT) in the four-county region, resulting in an average annual benefit of $2 billion from 2002 to 2020. These measures include a wide variety of transportation projects such as arterials, grade crossing improvements, high occupancy vehicle lanes, mixed flow lanes, hot lanes/tollways, transit, intelligent transportation systems, truck lanes, commuter rail, high speed rail, Maglev, and others. These projects have a combination of public and private funding.

Traffic congestion relief benefits were assessed for reductions in daily VMT for the period between 2002 and 2020. Reductions were calculated as the difference between baseline and control conditions for the benchmark years 2006, 2010, and 2020. Reductions in VMT were distributed to the 5 kilometer x 5 kilometer grid cell level using brake and tire wear in grams per mile and then aggregated up to the sub-regions in the four-county area according to the population distribution of the grid cells. Daily VMT reductions were converted to an annual reduction by multiplying by 250.

Implementation of the transportation control measures is projected to reduce VMT by 7.5 million miles in 2010 and by 9.7 million miles in 2020. VMT reductions were then allocated to three types of vehicles: passenger and light duty (86 percent), medium duty (7 percent), and heavy duty (7 percent) according to the proportion of annual vehicle miles traveled under the baseline conditions assigned to each type of vehicle. Reductions for each vehicle type were allocated to each sub-region, which was then multiplied by the per mile operating and maintenance cost of that vehicle type to arrive at the benefit of reduced travel. The operating and maintenance costs for passenger and light duty vehicle were assumed to be 14.4 cents per mile (Automobile Association of California, 2001). Operating and maintenance costs for medium duty and heavy duty trucks were assumed to be $1.12 per mile (American Trucking Association, 1998).

In the year 2010 an estimated $498 million of savings on operating and maintenance costs is expected. By the year 2020, the savings on vehicle operating and maintenance costs would increase to $644 million, as shown in Table 3-6.

TABLE 3-6
Reduced Vehicle Operating and Maintenance Costs by Type of Vehicle
(millions of 1997 dollars)

Type of Vehicle	2010	2020	Average Annual (2002-2020)
Passenger/Light Duty	$217	$281	$185
Medium Duty Trucks	136	176	116
Heavy Duty Trucks	145	187	123
Total	$498	$644	$424

Implementation of transportation control measures is projected to reduce VHT for business and commute trips by 800,828 hours in 2010 and 525,546 hours in 2020. For the purpose of this analysis, it was assumed that 44 percent of VHT reductions were for business and commute trips and 56 percent were for personal trips (Association of Bay Area Governments, 2002). Only VHT reductions for business and commute trips are considered. Of the 44 percent reductions in business and commute trips, it was further assumed that 14 percent was for business and 30 percent was for commute trips based on the 14 percent allocation of all VHT reductions to medium and heavy duty vehicles in the final 2003 AQMP.

VHT reductions for the sub-regions were allocated by multiplying the proportion of VHT within the sub-region by the appropriate hourly wage rate. Daily VHT reductions associated with commute trips were multiplied by an annual conversion rate of 250 and an hourly wage rate of $8.88, which is half of the average wage rate (BLS, 2003), to arrive at the annual benefit of spending less time on commuting. Daily VHT reductions from business trips were also multiplied by an annual conversion rate of 250 and an hourly wage rate of $27, the wage rate for truck drivers (SCAG, 2002c), to arrive at the annual benefit from VHT reductions for business trips.

Savings from reduced travel time for business and commute trips is estimated at $2.7 billion for 2010 and at $1.8 billion for 2020, as shown in Table 3-7.

TABLE 3-7
Savings from Reduced Travel Time by Trip Type
(millions of 1997 dollars)

Type of Trip	2010	2020	Average Annual (2002-2020)
Business	$1,593	$1,045	$946
Commute	1,127	740	669
Total	$2,720	$1,785	$1,614

Unquantified Benefits

Areas in which benefits from improved air quality have been identified but not fully quantified include human health, building materials, plant life and livestock, and reductions in vehicle hours traveled for personal trips. Each of these areas is discussed below.

Health Benefit

The quantifiable health benefits associated with improved air quality were assessed relative to reduced morbidity and mortality from ozone and PM10. The present state of knowledge does not allow all adverse health effects that have been identified to be measured and valued in dollars. Only 20 percent of the potential health impact areas (13 cubes out of 66 in Figure 3-2) can be quantified at this time. The contributions of ozone to premature death and to chronic bronchitis are two important impacts that are suspected, but have not been translated into dollar benefits. It should be noted that many health effects cannot be valued in dollars because, for example, sufficient data are not available with which to establish a quantitative relationship between pollutant level and health effect. These are "known effects" in Figure 3-2. A significant portion of the full monetary benefit of improved health from better air quality remains unquantified, as can be seen by the remaining cubes in Figure 3-2.

Quantification of health effects may be underestimated. The daily PM10 UAM AERO-LT (Long Term Urban Airshed Model) model simulations have not been completely evaluated at this time to quantify the daily PM10-related health effects. Therefore, daily PM10 projections that are based on the observed peak 24-hour value of a year and rollback estimation for future years are used instead.[6]

Agricultural Benefit

There are several categories of crops where the effects of ozone have not been determined (e.g., dates, nectarines, peaches, walnuts, and plums). Based on studies conducted at the Los Angeles Arboretum, half of the plants tested showed visible improvements resulting from reduced ozone levels. In the four-county area, the nursery stock industry represented $525 million (1997 dollars) in wholesale values in 2001.[7] However, data limitations do not allow quantitative assessments from improved air quality for these plants.

[6] Rollback refers to applying the rate of change between two observed data points to arrive at values for future years.
[7] 2001 Crop and Livestock Report, 2001 Orange County Crop Report, and 2001 Agricultural Production Report.

In addition, air contaminants can also damage livestock, just as they do human beings. In 2001, the total value of livestock and livestock products in the four-county area amounted to $121 million and $745 million (in 1997 dollars), respectively.[8]

Material Benefit

In addition to the quantifiable materials damage caused by ozone and PM10, a link exists between ozone, sulfur dioxide, PM10, and nitrogen oxides and ferrous metal corrosion; erosion of cement, marble, brick, tile, and glass; and the fading of fabric and coated surfaces. The damages and conversely the potential benefits from reducing the exposure cannot currently be quantified and valued in dollars.

Traffic Congestion Relief Benefit

Implementation of on-road control measures is projected to reduce daily VHT by 1,019,235 hours in 2010 for personal trips, as compared with the 2010 baseline projections for VHT. Savings resulting from reduced travel time are difficult to quantify due to the variation of the value of time from one individual to another. Based on one-half of the average hourly wage rate ($8.88), savings from reduced travel time for personal trips are estimated at $2.1 billion (1997 dollars) for the year 2010. This could bring the total traffic congestion relief benefit to approximately $4.8 billion in 2010.

COSTS

The cost of attaining clean air in the four-county area includes expenditures on control equipment, low-polluting materials, and infrastructure investments. To quantify these costs, the two-step methodology described in Chapter 1 was applied. The majority of these costs are estimated based on currently available technology. Advancements in technology could lower these costs in the future. The costs associated with control strategies for 30 percent of the emission reductions for the draft final 2003 AQMP can be quantified. The cost for the remaining 70 percent emission reductions can only be approximated due to lack of data on control strategy for emitting sources.

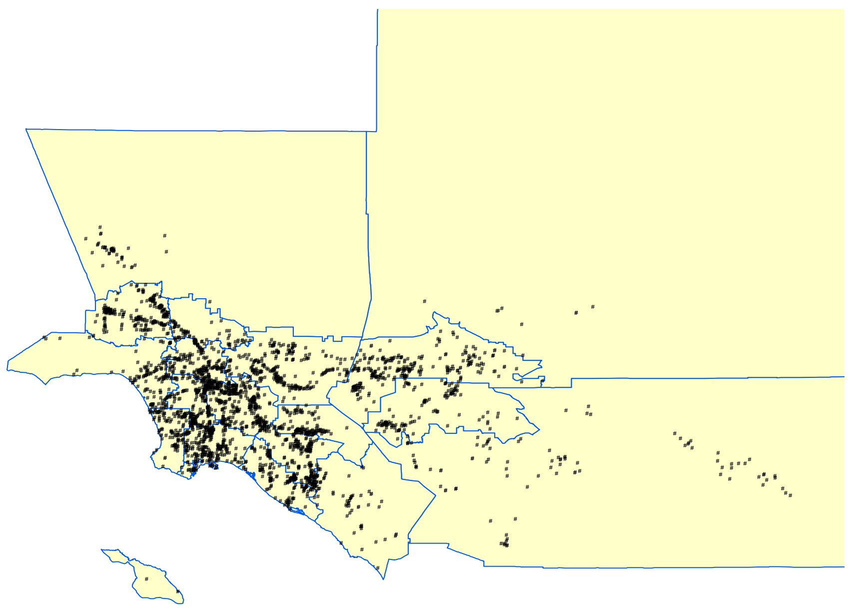
Quantifiable Measures

Cost data was developed for each quantified control measure for all the point sources in the District and allocated to the industries and sub-regions to which the affected point sources belong based on the projected emission reductions in the draft final 2003 AQMP and the 1997 emission inventory data, as shown in Figure 3-3. For area, on-road, and off-road sources the cost for each measure was allocated to 19 sub-regions based on emission reductions at each air quality grid and then to regulated industries in each sub-region. The cost here is comprised of the annual operating and maintenance expenditure and capital expenditure annualized over the economic life of equipment at the 4-percent real interest rate. The CARB provided the cost data on the measures over which it has jurisdiction. The cost of control measures under the District's jurisdiction does not include contingency, construction associated with the re-design of a

[8] Ibid.

facility to accommodate the new required device, and permitting. The cost associated with these categories will be considered during rulemaking process.

Figure 3-3
Point Source Location in the 1997 Emission Inventory



There are 218 public and private projects listed plus three measures from the 1997/1999 AQMP in the transportation control measures identified by the Southern California Association of Governments (SCAG). Affected sub-regions are identified for each project. Annualized capital cost and annual operating and maintenance costs were calculated for each project within its implementation period. SCAG also identified that these public projects would be financed by local sales tax, state sales tax on gasoline sales, alternative fuel tax, and motor vehicle tax and user fees. Private funding includes toll or fare revenue, Amtrak and local airport and city contributions, bonds, and the TIFIA (Transportation Infrastructure Finance and Innovation Act) credit program. The cost burden is distributed to each county according to the proposed tax share in each county. Within each county the burden is distributed to each sub-region based on the proportion of sub-region population in the county.

Three SCAG transportation measures that have been carried over to the 2003 AQMP from the 1997/1999 AQMP are consolidated into Control Measure TCM-1B (Transit and Systems Management). The same pattern of costs that were used for the previous AQMP analysis was extended to 2020. This step is necessary since the period of analysis for previous AQMPs ended in 2010. The 2001 vehicle registration data for autos at the zip code level from the

California Department of Motor Vehicle (2002) was used to bring the previous county-level analysis to the sub-regions within each individual county.

The average annual control cost of all quantifiable control measures is projected to be $1.63 billion from 2002 to 2020.[9] Figure 3-4 shows the annual costs of quantified measures. The trend is going upward mainly because of the spread of implementation dates among a number of projects under the transportation control measures after the year 2014. Table 3-7 shows the distribution of control costs for these measures among various industries. The share of these control costs relative to industry output is also presented in Table 3-7. Among all of the sectors, the other transportation sector (SIC 44, 46-47) where water transportation belongs has the highest cost ($351 million) and the highest percentage of cost in its output (4.2 percent) due to the implementation of several marine measures. The sectors of government, retail trade (SICs 52-59), and construction (SICs 15-17) also have relatively higher costs than other sectors. The high cost for the government sector is because of a large amount of infrastructure investment (roadway technology for intelligent transportation systems) assumed to be made by this sector for Control Measure TCM-1B. The cost for the retail trade sector mainly comes from Control Measure TCM-1B where the share of sectoral employment was used for cost distribution to all sectors. For some sectors such as the sector of private household (SIC 88), the control cost may be relatively low and yet the cost in terms of percentage of output is relatively high. This is because a few measures affect almost all the industries in the District and these sectors are relatively small compared to other industries in the four-county economy. As a result, the share of small costs in the overall production of these industries becomes relatively high.

Consumers have a relatively large share of the transportation projects since they are assumed to be financed by increases in various taxes. However, this is more than offset by the savings employed by Control Measures TCM-1B. The savings would come from less frequent commute due to telecommuting, the reduction in solo driving due to the use of smart shuttles, and the use of alternate routes due to the deployment of on-board vehicle and highway intelligence systems. The net savings for consumers is projected to be close to $92 million annually.

[9] Some transportation control measures had implementation dates prior to 2003.

Figure 3-4
Control Cost by Year

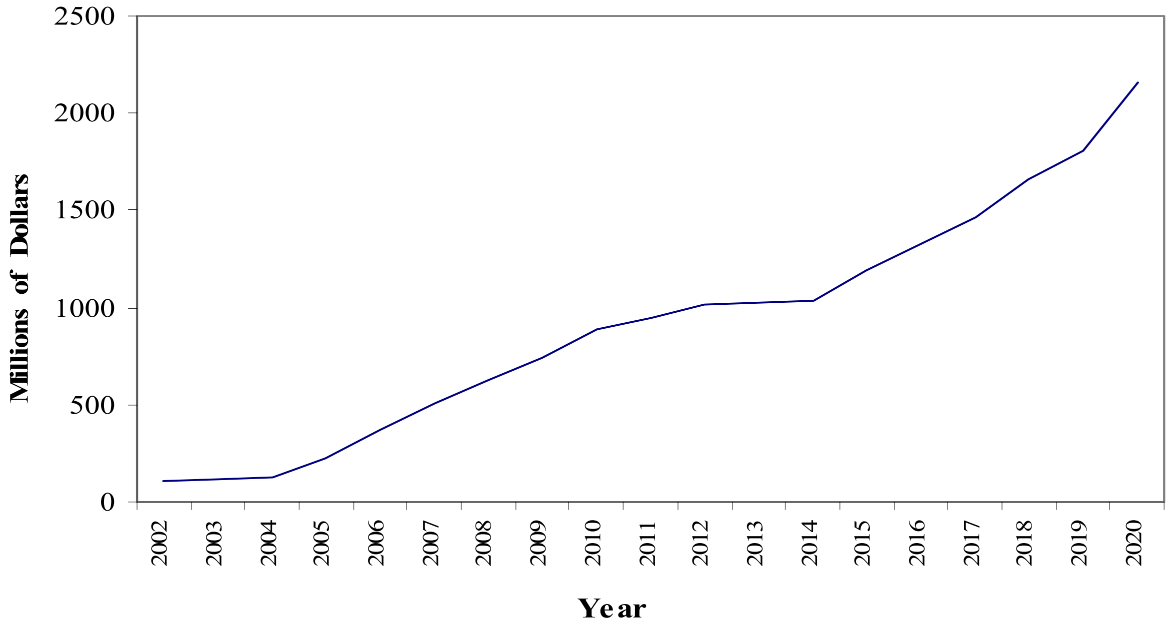


TABLE 3-7

Average Annual Control Cost by Industry and as a Percentage of Industry Output (2002-2020)

Industry (SIC)	Costs (millions of 97$)	Percent of Output
Lumber (24)	$6	0.16%
Furniture (25)	12	0.16%
Stone, Clay, etc. (32)	8	0.17%
Primary Metals (33)	6	0.06%
Fabricated Metal (34)	20	0.12%
Non-electric Machinery (35)	19	0.01%
Elect. Equipment (36)	19	0.03%
Motor Veh. (371)	5	0.06%
Rest of Transp. Equip. (372-379)	25	0.07%
Instruments (38)	20	0.06%
Misc. Manuf. (39)	9	0.16%
Food (20)	17	0.07%
Tobacco Manuf. (21)	0	0.34%
Textiles (22)	6	0.17%
Apparel (23)	34	0.25%
Paper (26)	7	0.12%
Printing (27)	21	0.18%
Chemicals (28)	12	0.07%
Petroleum Products (29)	14	0.06%

TABLE 3-7

(Continued)

Industry (SIC)	Costs (millions of 97$)	Percent of Output
Rubber (30)	12	0.09%
Leather (31)	1	0.41%
Mining (10,12-14)	2	0.08%
Construction (15-17)	80	0.16%
Railroad (40)	5	0.36%
Trucking (42)	70	0.29%
Local/Interurban (41)	3	0.17%
Air Transp. (45)	19	0.12%
Other Transp. (44,46-47)	351	4.20%
Communication (48)	9	0.02%
Public Utilities (49)	8	0.05%
Banking (60)	15	0.07%
Insurance (63,64)	16	0.10%
Credit & Finance (61-62,67)	15	0.04%
Real Estate (65,69)	32	0.02%
Eating & Drinking (58)	54	0.26%
Rest of Retail (52-57,59)	93	0.13%
Wholesale (50-51)	54	0.05%
Hotels (70)	10	0.19%
Personal Serv. & Repair (72,76)	27	0.22%
Private Household (88)	12	1.13%
Auto Repair/Serv. (75)	13	0.07%
Misc. Busi. Serv. (73)	81	0.09%
Amuse. & Recreation (79)	22	0.17%
Motion Pictures (78)	21	0.07%
Medical (80)	57	0.12%
Misc. Prof. Serv. (81,87,89)	52	0.11%
Education (82)	19	0.21%
Non-Profit Org. (83)	22	0.20%
Agri/Forest/Fish Serv. (07-09)	28	0.88%
Government*	250	
Consumers	-92	
Farm	8	
Total	$1,629	

*There are no published dollar estimates for the output of the government sector.

Cost by County

Table 3-8 shows how the potential control costs are distributed among the four counties for the quantifiable measures. Los Angeles County could incur an annual cost of about $922 million, or approximately 57 percent share of the total cost. This is because most of the affected emission sources are located in Los Angeles County.

TABLE 3-8

Average Annual Control Cost by County
(millions of 1997 dollars)

County	Control Cost
Los Angeles	$922
Orange	344
Riverside	170
San Bernardino	192
TOTAL	$1,629

The sum of individuals may not add to the total due to rounding.

Unquantifiable Measures

Thirty-one measures are quantified with costs, which include 11 AQMD, 5 CARB area source, 5 on-road mobile, 7 off-road mobile source, and 3 SCAG transportation measures. Among the possible long-term federal emission reduction approaches that are identified by the CARB, costs are quantified for control strategies in the area of on-road heavy duty trucks, harbor craft and ocean-going ships, and jet aircraft (part of Tier II of long-term measures). The weighted cost effectiveness by type for these quantified measures and strategies is shown in Table 3-9.[10] The weights are emission reductions of individual measures within each type.

TABLE 3-9

Weighted Cost Effectiveness by Measure Type

Control Measure Type	Cost Effectiveness (1997$/ton)
AQMD Measures	$10,183
CARB Area Source Measures	$4,285
CARB & US EPA On Road Measures	$12,223
CARB & US EPA Off Road Measures	$7,089

On average, the total estimated cost for the unquantified portion of the draft final Plan is projected to be $1,620 million annually. The cost of unquantified measures was estimated based on the weighted cost effectiveness of quantified measures and the annual emission reductions of unquantified measures in 2010. The calculation for the unquantified long term Tier I and II measures is performed by dividing their emission reductions into those four types (AQMD measures, CARB area source measures, CARB & US EPA on road measures, and CARB & US EPA off road measures) which was then multiplied by the corresponding weighted cost effectiveness values. These estimates are rough projections and actual costs could be lower or higher.

[10]Control Measures TCM-1A, TCM-1B, and TCM-1C, which are part of the Regional Transportation Improvement Plan (RTIP), were not included in the calculation. This is because these measures were proposed not only for air quality benefit but for regional mobility. Therefore, emission reductions alone are not sufficient to capture the entire benefit of these measures.

Based on a public request, a sensitivity analysis was performed by selecting the lowest and highest cost effectiveness values from each type of control measures listed in Table 3-9, which were then used to approximate the cost of the Long Term Tier I and II Measures. The sensitivity test shows that the total cost of these unquantifiable measures could range from $350 to $3,106 million annually.

SUMMARY

The Urban Airshed Model and PM10 model project the attainment of the federal air quality standards of ozone in 2010 and PM10 in 2006, respectively. The total quantified benefit in 2010 is estimated to be $7.8 billion and increase to $9.7 billion in 2020 (Table 3-10). The quantified health benefits have not accounted for the reduction in all adverse health effects due to the implementation of the final 2003 AQMP. In addition, benefits have not been quantified for reductions in vehicle hours traveled for personal trips; and reductions in damages to plants, livestock, and forests as a result of implementing the 2003 AQMP. When all these are considered, the estimated benefits will be higher than what the estimates presented in this analysis.

The total cost of the draft final Plan is projected to be at $3.5 billion in 2010 and increase to $5 billion in 2020. However, since 70 percent of the intended total emission reductions belong to the unquantified measures, uncertainty exists regarding how reliable the average cost effectiveness of quantified measures would be in projecting the relatively large size of the black box. On the other hand, past experience has shown that new technology develops faster than what has been expected and its cost declines over time. A sensitivity test rendered on the unquantified measures shows that the total cost of the final Plan (quantified and unquantified measures) could range from a low of $1,974 to a high of $4,730 million annually, on average.

TABLE 3-10

Total Costs and Benefits of the Draft Final Plan
(millions of 1997 dollars)

	2010	2020	Average Annual (2002 - 2020)
Total Costs	$3,468	$4,979	$3,249
Quantified Measure Costs	1,848	3,359	1,629
Unquantified Measure Costs	1,620	1,620	1,620
Total Quantified Benefits	$7,794	$9,723	$6,639

Further research is needed relative to quantifying the known health effects. Relative to costs, additional efforts will be made to work with the CARB and U.S. EPA to quantify the costs associated with the black box. Expansion of the AQMD's jurisdiction over certain mobile sources will also be examined. Chapter 8 has a more detailed description of these proposed future actions relative to enhanced benefit and cost assessments.

CHAPTER 4

EMPLOYMENT IMPACTS

INTRODUCTION

The employment impacts of quantified control measures and clean air benefit were performed by utilizing the Regional Economic Model, Inc. (REMI) model. The REMI model is also used to assess the potential impacts on job and income distribution, product prices, profits, imports, and exports (Chapters 5 and 6). The REMI model contains 19 sub-regions within the four-county area. Each sub-region is comprised of 53 public and private sectors. The structure of each sub-region's economy is represented through production, sales, and purchases between sectors; demand for and supply of products in each sector; expenditures made by consumers, businesses, and governments; and product flows between one sub-region, the rest of sub-regions, and the rest of U.S.

The employment impact analysis was performed separately for quantified control measures and clean air benefits since quantified control measures represent only 30 percent of the total emission reductions required for meeting the air quality standards and quantification of benefits includes all the intended emission reductions. The relatively large size of emission reductions from and the limit data on unquantified measures do not lend themselves to carry forward any projections of job impacts for unquantified measures. The employment impacts in this chapter represent deviations from the baseline regional job growth line illustrated in Figure 2-2.

Alternatively, an employment impact analysis could be performed for the quantified measures (representing 30 percent of the total emission reductions only) and their corresponding air quality benefits. However, these measures are not expected to bring the Basin into the attainment of the air quality standards. The resulting employment analysis would thus not be meaningful.

JOB IMPACTS FROM QUANTIFIED MEASURES AND BENEFITS

Implementation of the 2003 AQMP will improve visibility, decrease expenditures on household cleaning and on refurbishing building surfaces and replacing tires, reduce morbidity and mortality, reduce congestion, and increase crop yields, as discussed in Chapter 3. The quantifiable total annual benefit for measures proposed in the draft final 2003 AQMP amounts to approximately $7.8 billion in 2010. The quantified measures which represent 30 percent of the emission reductions intended for attainment will result in an annual cost of approximately $1.8 billion in 2010. Both benefits and costs will affect the employment base in the four-county economy.

The four-county economy will expand from the effects of two major forces resulting from cleaner air. First, the substitution of imports [general consumer purchases (which would increase due to the reduction in health care expenditures)] for local production (reduced health care services related to improved air quality) leads to jobs not created.[1] Second, the improvement in the quality of life will make the area more attractive so that more people will move in until the expected real earnings rate is reduced enough to compensate for the estimated effect of the increased amenities. This influx will increase the labor force and increase local

[1] General consumer purchases can be satisfied by local production and imports. Health care services are locally produced goods.

demand. On the other hand, the local economy will also experience relative slowdown from implementing control measures. This is because the increased cost of doing business leads to fewer jobs created due to the location effect and to the higher costs that reduce consumer purchasing power. Table 4-1 shows the average annual job impacts as well as impacts with respect to the years 2010 and 2020 for quantified control measures and benefits, respectively.

TABLE 4-1

Job Impacts of Quantified Clean Air Benefits and Quantified Measures

Category	2010	2020	Average Annual
Quantified Benefits	51,070	62,980	41,934
Congestion Relief	48,710	51,420	37,577
Visibility Improvements	996	4,228	1,881
Reduced Materials Expenditures	1,030	1,449	1,002
Health Benefits	-240	4,966	1,691
Increased Crop Yields	559	462	500
Quantified Control Measures	10,650	-20,570	-9,893
AQMD	-3,854	-5,050	-3,421
CARB & U.S. EPA	-8,603	-10,580	-6,897
SCAG	23,070	-5,046	-171

Results from modeling all the categories are slightly different from the sum of results from modeling each category one at a time because of nonlinearity of the REMI model.

The job impact of air quality benefits is assessed separately for each benefit category: visibility improvements, increased crop yields, health benefits, reduced congestion, and reduced expenditures on materials. Many of the benefits of improved air quality can be seen as both direct and indirect benefits to individuals living in the area. For example, reductions in out-of-pocket health expenditures are used as a proxy for the quality-of-life value of morbidity benefits (i.e., reduced illness). Due to improved air quality the growth of health-related occupations may decrease as health expenditure decreases. Nevertheless, a net gain of approximately 1,691 more jobs annually from the increased attractiveness of the area is still projected. Moreover, decreased congestion could create an additional 37,577 jobs. The job creation is due to the reduction in the transportation cost for businesses and consumers. The savings can then be invested or spent elsewhere to stimulate the economy. Additionally, less congestion increases the amenity of the local area, which will then become more attractive to businesses and economic migrants in their relocation and migration decision. Together, the quantified benefits could result in an average of 41,934 jobs created annually.

The total projected employment without the AQMP in 2010 is 10.1 million jobs. The quantifiable control measures will result in an average of 9,893 jobs forgone annually, on average, over the period from 2002 to 2020. The 218 transportation projects alone are projected to result in 3,763 jobs created from constructing and maintaining highway and transit (bus and rail) infrastructure. These projects will be funded through local revenue sources and the out-of-area funding sources (state and federal governments). However, it should be noted that the costs of these infrastructure projects will continue to be paid for long after these projects are completed. The remaining control measures are projected to result in jobs forgone.

Job Impacts by Industry

Table 4-2 shows the average annual job impact by industry between 2002 and 2020 and with respect to the years 2010 and 2020 for quantified clean air benefits and measures separately. In total, cleaner air would result in creation of 41,934 jobs annually, on average, from 2002 to 2020 which is approximately 0.41 percent of the baseline jobs during the same period. The sectors that are projected to have the relatively large share of jobs created are the sectors of retail trade (SICs 52-59), miscellaneous business services (SIC 73), and governments. As the area becomes more attractive due to cleaner air, more people will move in and thus demand more services from governments. The jobs forgone in the trucking and warehousing (SIC 41) and health services (SIC 80) sectors in earlier years are due to the reduced demand for trucking services as a result of fewer hours traveled and reduced health-related expenditures to the medical sector as a result of improved air quality, respectively. In later years, the stimulus from continued improvement in air quality would benefit all the sectors in the local economy.

Implementation of quantified measures would, on the other hand, result in an average of 9,893 jobs forgone, annually from 2002 to 2020. The jobs forgone represent 0.1 percent of the baseline jobs during the same period. At the sectoral level, manufacturers of transportation equipment (SICs 372-379) and the sectors of construction and auto repairs (SIC 75) are projected to experience additional jobs created. A number of on- and off-road measures would stimulate additional demand for transportation equipment and auto services and thus benefiting the sectors producing these goods. The heavy infrastructure investment resulting from the 218 transportation projects would certainly benefit the construction industry. While investments in roadway technology and other infrastructure made by the government sector benefit a number of other sectors, the government sector itself is projected to experience jobs forgone due to the reduced spending elsewhere in order to compensate for the increase in investments. The sectors of retail trade and miscellaneous business services are projected to have relatively large share of jobs forgone mainly due to the reduction in personal income resulting from the overall jobs forgone in the economy.

TABLE 4-2
Employment Impacts by Industry for
Quantified Clean Air Benefits and Quantified Measures

	Quantified Benefits						Quantified Measures					
	2010		2020		Average Annual (2002-2020)		2010		2020		Average Annual (2002-2020)	
Industry (SIC)	Jobs	% Baseline	Jobs	% Baseline	Jobs	% Baseline	Jobs	% Baseline	Jobs	% Baseline	Jobs	% Baseline
Lumber (24)	262	1.00	313	1.07	214	0.79	7	0.03	-85	-0.29	-47	-0.17
Furniture (25)	388	0.74	428	0.64	305	0.53	-184	-0.35	-306	-0.45	-213	-0.37
Stone, Clay, etc. (32)	236	0.97	254	1.02	184	0.75	161	0.66	146	0.59	62	0.25
Primary Metals (33)	186	0.76	264	0.97	169	0.66	-13	-0.05	-88	-0.32	-44	-0.17
Fabricated Metal (34)	505	0.59	655	0.67	431	0.48	21	0.02	-224	-0.23	-106	-0.12
Industrial Machinery & Equipment (35)	369	0.46	278	0.31	243	0.30	-134	-0.17	-177	-0.20	-168	-0.21
Elect. Equipment (36)	349	0.40	322	0.40	254	0.29	-69	-0.08	605	0.75	192	0.22
Motor Veh. (371)	98	0.48	120	0.55	82	0.38	-10	-0.05	-28	-0.13	-22	-0.10
Rest of Transp. Equip. (372-379)	247	0.22	280	0.25	197	0.18	9856	8.97	1003	0.89	3758	3.39
Instruments (38)	318	0.38	339	0.40	249	0.29	-291	-0.35	-257	-0.30	-229	-0.27
Misc. Manuf. (39)	237	0.63	270	0.79	192	0.51	-127	-0.33	-175	-0.51	-115	-0.30
Food (20)	482	0.82	480	0.84	359	0.61	-167	-0.29	-246	-0.43	-155	-0.26
Tobacco Manuf. (21)	0	-0.01	0	-0.01	0	-0.01	0	-0.01	0	0.00	0	0.00
Textiles (22)	170	0.92	204	1.14	140	0.73	-87	-0.47	-121	-0.67	-78	-0.41
Apparel (23)	347	0.45	300	0.58	252	0.32	-263	-0.34	-306	-0.59	-211	-0.27
Paper (26)	207	0.95	287	1.21	184	0.82	-130	-0.60	-163	-0.69	-113	-0.50
Printing (27)	386	0.47	511	0.56	331	0.39	-129	-0.16	-299	-0.33	-170	-0.20
Chemicals (28)	369	0.97	499	1.37	328	0.86	121	0.32	179	0.49	87	0.23
Petroleum Products (29)	56	1.00	58	1.24	44	0.78	-152	-2.72	-232	-4.95	-156	-2.76
Rubber (30)	311	0.59	433	0.83	282	0.53	-186	-0.35	-190	-0.36	-144	-0.27
Leather (31)	34	1.00	32	1.17	25	0.73	-25	-0.71	-29	-1.06	-19	-0.55
Mining (10,12-14)	31	0.42	24	0.37	21	0.28	-32	-0.44	-44	-0.69	-36	-0.48
Construction (15-17)	5518	1.08	3901	0.70	3531	0.70	9853	1.93	10060	1.82	5223	1.04
Railroad (40)	18	0.35	17	0.38	13	0.26	20	0.39	-23	-0.52	-3	-0.07
Trucking (42)	-85	-0.06	4104	3.12	1640	1.24	-278	-0.21	-517	-0.39	-350	-0.26
Local/Interurban (41)	283	0.65	391	0.72	240	0.54	-112	-0.26	-381	-0.70	-167	-0.38
Air Transp. (45)	329	0.39	340	0.41	248	0.30	-188	-0.22	-460	-0.55	-231	-0.28
Other Transp. (44,46-47)	172	0.21	500	0.48	241	0.29	-676	-0.83	-4016	-3.86	-1387	-1.65
Communication (48)	646	0.58	512	0.47	431	0.40	-176	-0.16	-234	-0.22	-181	-0.17
Public Utilities (49)	294	0.73	368	0.69	238	0.56	-46	-0.12	-132	-0.25	-122	-0.29
Banking (60)	1024	0.73	905	0.71	726	0.53	-215	-0.15	-369	-0.29	-249	-0.18
Insurance (63,64)	770	0.45	1135	0.54	687	0.38	-227	-0.13	-620	-0.29	-312	-0.17
Credit & Finance (61-62,67)	1155	0.56	1155	0.60	864	0.44	-291	-0.14	-492	-0.26	-327	-0.17
Real Estate (65)	572	0.19	411	0.13	374	0.13	51	0.02	78	0.03	-14	0.00
Eating & Drinking (58)	4672	0.87	4376	0.72	3283	0.60	-346	-0.06	-1253	-0.21	-715	-0.13
Rest of Retail (52-57,59)	7175	0.70	6322	0.60	4961	0.48	-2608	-0.25	-6874	-0.65	-3854	-0.38

TABLE 4-2
(Continued)

	Quantified Benefits						Quantified Measures					
	2010		2020		Average Annual (2002-2020)		2010		2020		Average Annual (2002-2020)	
Industry (SIC)	Jobs	% Baseline	Jobs	% Baseline	Jobs	% Baseline	Jobs	% Baseline	Jobs	% Baseline	Jobs	% Baseline
Wholesale (50-51)	2720	0.49	2413	0.42	1904	0.34	-1662	-0.30	-3593	-0.62	-2321	-0.42
Hotels (70)	601	0.55	994	0.73	572	0.50	-378	-0.35	-434	-0.32	-303	-0.26
Personal Serv. & Repair (72,76)	1467	0.54	1572	0.51	1115	0.40	-238	-0.09	-669	-0.22	-409	-0.15
Private Household (88)	479	0.57	384	0.46	318	0.36	-104	-0.12	-132	-0.16	-85	-0.10
Auto Repair/Serv. (75)	820	0.53	1226	0.66	741	0.48	2356	1.52	513	0.28	644	0.41
Misc. Busi. Serv. (73)	5181	0.46	6135	0.49	4164	0.38	-1760	-0.16	-3545	-0.28	-2445	-0.22
Amuse. & Recreation (79)	1352	0.60	1182	0.50	940	0.42	-328	-0.15	-490	-0.21	-326	-0.15
Motion Pictures (78)	269	0.13	263	0.16	207	0.11	-215	-0.11	-151	-0.09	-148	-0.08
Medical (80)	-1121	-0.16	2284	0.27	335	0.05	227	0.03	587	0.07	260	0.04
Misc. Prof. Serv. (81,87,89)	3384	0.55	3748	0.50	2643	0.41	163	0.03	-686	-0.09	-756	-0.12
Education (82)	1401	0.72	994	0.49	897	0.46	-316	-0.16	-235	-0.11	-204	-0.10
Non-Profit Org. (83-84,86)	2048	0.79	1916	0.66	1454	0.56	-421	-0.16	-838	-0.29	-493	-0.19
Agri/Forest/Fish Serv. (07-09)	626	0.46	815	0.49	510	0.37	-309	-0.23	-937	-0.56	-462	-0.33
Government (91-97)	3448	0.32	8012	0.69	4019	0.38	704	0.07	-3689	-0.32	-2229	-0.21
Farm (01-02)	265	0.97	259	1.05	152	0.55	0	0.00	0	0.00	0	0.00
Total	51070	0.50	62980	0.57	41934	0.41	10650	0.10	-20570	-0.19	-9893	-0.10

Small Business Effects

The AQMD defines a "small business" in Rule 102 as one which employs 10 or fewer persons and which earns less than $500,000 in gross annual receipts. In addition to the AQMD's definition of a small business, the federal Small Business Administration (SBA), the federal Clean Air Act Amendments of 1990 (CAAA), and the California Department of Health Services (DHS) also provide their own definitions of a small business. Two common characteristics of the SBA, CAAA, and DHS small business definitions are the following: (1) standards are unique to each industry type, and (2) the businesses have to be independently owned and operated, and cannot be dominant in their field.

The SBA's definition of a small business uses the criterion of either gross annual receipts (ranging from $0.5 million to $17 million, depending on industry type) or number of employees (ranging from 100 to 1,500). The CAAA classifies a facility as a "small business stationary source" if it (1) employs 100 or fewer employees, (2) does not emit more than 10 tons per year of either ROG or NO_X, and (3) is a small business as defined by SBA. The DHS definition of a small business uses an annual gross receipt criterion (ranging from $1 million to $9.5 million, depending on industry type) for non-manufacturing industries and an employment criterion of fewer than 250 employees for manufacturing industries.

Under the SBA's and CAAA's definitions of small business, the AQMP could potentially impact a wide range of small businesses. The number of affected small businesses will be fewer under the AQMD's definition. Small businesses are more highly concentrated in non-manufacturing than manufacturing sectors. Since the affected businesses are not exactly known at this stage, additional analyses of the number and types of small businesses affected by each control measure will be performed during the individual rule development processes.

SUMMARY

Without the AQMP, jobs in the four-county area are projected to grow at an annual rate of about 1.069 percent between 2002 and 2020. Cleaner air would bring the job growth to an annual rate of 1.1 percent. On the other hand, the quantified measures would slow down the job growth rate to 1.054 percent. The four-county region is projected to have 11 million jobs in 2020. The jobs created from quantified clean air benefits would amount to 0.57 percent of the 2020 baseline jobs. The jobs forgone from quantified measures would be close to 0.2 percent of the 2020 baseline jobs.

The medical sector would experience jobs forgone in earlier years due to reductions in illness from cleaner air. The industries of construction and auto repair services and manufacturers of transportation equipment would experience additional jobs created due to additional demand for their products as required by on- and off-road control measures.

The small business impact of individual control measures will be examined in the rule development process. The employment impact associated with unquantified measures will be examined further as costs of these measures are developed. In addition, as these measures are developed into rules, their potential employment impacts will be specifically assessed. Chapter 8 has a more detailed description of these future assessments.

CHAPTER 5

IMPACTS ON ETHNIC AND ECONOMIC GROUPS AND COMMUNITIES

INTRODUCTION

Socioeconomic issues have become increasingly important in recent years during the development of air quality regulations and policies. Evaluation of the distribution of job and cost impacts among ethnic and economic groups as well as geographic communities is a key topic to be considered.

While a socioeconomic assessment provides valuable information regarding the potential direct and secondary effects, the analysis does have some limitations. Establishing appropriate methods to estimate distribution effects is difficult because the socioeconomic assessment in the air pollution area is a relatively new field. Few analytical models exist that can be easily adapted to air quality policy analysis. Moreover, there is an inherent bias because costs tend to be more easily measured than benefits. Finally, there are additional uncertainties associated with examining subpopulations within the four-county area. Overall, socioeconomic assessments require substantially more data than what currently exists because existing data are often limited or based on small samples, thereby making estimates less reliable.

It is not possible at this time to quantify the costs associated with every control measure or the benefits associated with every effect of clean air. Thirty-one short-term measures along with some long-term measures were quantified. Costs for the other measures are not available at this time because specific source categories, control efficiencies, emission reductions, or costs of control technologies are not presently known. The measures whose costs cannot be quantified command 70 percent of the total emission reductions intended for the attainment.

The REMI model, used to analyze potential impacts of the 2003 AQMP, projects possible impacts on jobs, the distribution of jobs, income, and product prices based upon the input of cost data for the quantified control measures and benefit data for each quantified effect of clean air. The reliability of such projections is dependent upon the validity of the input. The AQMD staff believes that it would be inappropriate to make assumptions relative to job impacts on ethnic groups for unquantified measures and benefits. The analysis contained herein, therefore, considers only those measures and benefits for which quantification is available. Furthermore, the job and other socioeconomic impacts from control measures and clean air are presented separately due to the relatively large size of emission reductions from unquantified measures. These impacts should not be summed since the clean air benefits were based on all the emission reductions intended for the attainment.

CLEAN AIR BENEFITS BY SUB-REGION

The four-county area is projected to attain the federal PM10 standard in 2006 and the federal ozone standard in 2010. Air quality benefits occur throughout the Basin. The quantified health benefits from reductions in PM10 and ozone are expected to reach nearly $2.5 billion in 2010 and $2.6 billion annually, on average, from 2005 to 2020. When compared with the baseline "no control" scenario, the south central portion of Los Angeles County and Chino-Redlands area show the greatest reduction in PM10 and ozone concentration and hence the greatest health benefit. Seventy-seven percent of the agricultural benefit congregates in the non-urbanized Riverside County (Table 5-1). The majority of the congestion relief benefit would be attributed to the eastern portion (the San Gabriel Valley) of Los Angeles County and the Chino-Redlands area.

TABLE 5-1

Average Annual Benefits (2002-2020) by Sub-region

	Health		Agriculture		Congestion Relief		Material		Visibility		Total	
Sub-region	MM $	%	MM $	%	MM $	%	MM $	%	MM $	%	MM $	%
LA CO Burbank	128	5%	0	0%	63	3%	3	4%	103	5%	297	4%
LA CO San Fernando	117	5%	0	0%	144	7%	5	7%	121	6%	387	6%
LA CO West	198	8%	0	0%	132	6%	4	7%	231	12%	566	9%
LA CO Central	137	5%	0	0%	142	7%	5	8%	118	6%	402	6%
LA CO South Central	415	16%	0	0%	82	4%	3	5%	48	2%	548	8%
LA CO South	167	6%	0	0%	115	6%	3	5%	126	7%	412	6%
LA CO East	155	6%	0	0%	215	11%	6	9%	142	7%	516	8%
LA CO Southeast	92	4%	0	0%	136	7%	4	6%	98	5%	330	5%
LA CO Island	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
LA CO Beach	91	4%	0	1%	61	3%	3	4%	147	8%	302	5%
LA CO North	19	1%	0	0%	72	4%	2	3%	29	2%	122	2%
ORANGE CO North	61	2%	0	1%	68	3%	2	3%	64	3%	195	3%
ORANGE CO Central	156	6%	0	0%	133	7%	3	5%	81	4%	374	6%
ORANGE CO South	104	4%	2	11%	146	7%	4	6%	177	9%	433	7%
ORANGE CO West	94	4%	0	2%	85	4%	3	5%	150	8%	332	5%
Northwest Riverside	210	8%	1	4%	117	6%	3	5%	84	4%	415	6%
Other Riverside	86	3%	14	77%	123	6%	5	8%	96	5%	325	5%
Chino-Redlands	275	11%	0	2%	190	9%	4	7%	104	5%	574	9%
Other San Bernardino	74	3%	0	2%	15	1%	2	3%	19	1%	110	2%
Total	**2,579**	100%	**18**	100%	**2,038**	100%	**63**	100%	**1,940**	100%	**6,639**	100%

The west portion of Los Angeles County is projected to have the highest share of the visibility aesthetic benefit, which are calculated based on the number of households, visibility improvements (compared to the “no control” baseline scenario), net household income (net of housing cost), and percent of college degree holders in each sub-region. Table 5-2 shows the values of these variables by sub-region. The values of socioeconomic variables came from the 2000 census. In 2006, the non-urbanized San Bernardino County is projected to have the highest visibility improvement relative to its baseline air quality (2.1%) among all the sub-regions. In 2010, the northwest Riverside County would show the highest visibility improvement (nearly 16% from its baseline air quality).

Information on net household income and percent of college degree holders for the benchmark years 2006, 2010, and 2020 is not available. The annual growth rates of net household income and percent of college degree holders, respectively, between the 1990 and 2000 census in each sub-region were used to project the values of these variables for those benchmark years. Additionally, SCAG household projections were used. Despite that visibility in Inland Empire is projected to improve the most relative to all other sub-regions, the total willingness to pay for visibility improvement is higher in the sub-regions with denser population due to their higher net household income and percentage of college degree holders.

TABLE 5-2
Determining Factors for Aesthetic Visibility Benefit by Sub-region

Sub-region	Households	Net Household Income 1995 $	% College Degree	% Visibility Improvement 2006	2010
LA CO Burbank	214,768	$40,682	34	0.0	9.6
LA CO San Fernando	401,319	37,141	24	1.5	7.2
LA CO West	381,637	53,335	51	0.0	7.5
LA CO Central	418,719	22,030	21	1.5	7.9
LA CO South Central	270,100	20,468	7	0.0	9.5
LA CO South	288,061	33,365	21	1.4	12.2
LA CO East	464,470	40,849	24	0.7	8.0
LA CO Southeast	317,450	32,501	13	1.9	11.4
LA CO Island	1,281	31,826	21	0.3	7.3
LA CO Beach	214,644	48,933	37	1.1	10.5
LA CO North	161,325	44,048	21	0.0	6.2
ORANGE CO North	135,372	50,701	33	0.6	10.2
ORANGE CO Central	267,466	36,707	15	0.6	11.1
ORANGE CO South	289,000	61,594	44	1.0	9.0
ORANGE CO West	243,449	53,642	35	0.0	10.4
Northwest Riverside	199,707	38,903	17	1.1	15.9
Other Riverside	301,474	35,572	17	1.5	10.3
Chino-Redlands	375,585	36,102	17	1.1	9.5
Other San Bernardino	149,043	32,252	14	2.1	5.7

The health and agricultural benefits were calculated at the 5 kilometer by 5 kilometer grid level and aggregated to the 19 sub-region level using the air quality projections from the Urban Airshed Model and the PM10 model. The visibility benefit analysis was performed at the 19 sub-region level by aggregating the predicted PM10 concentration data for each grid and the total light extinction coefficient at the nearest airport for each grid to 19 sub-regions. The congestion relief benefit was assessed by aggregating the reductions in VMT and VHT at the air quality grid level to 19 sub-regions. The assessment of material benefit was performed at the county level and allocated to sub-regions according to their population and housing units within a county. All the assessments were first made for the benchmark years (2010 for ozone and 2006 and 2010 for PM10) in the air quality models and interpolated for interim years. The 2020 benchmark year for both pollutants was created by assuming that the performance in 2010 as a result of the 2003 AQMP would continue in 2020.

COSTS BY SUB-REGION

The 2003 AQMP requires emission reductions from stationary, area, on-road, and off-road sources. Emission reductions from stationary sources consist of those from permitted (point) and non-permitted (area) sources. Projected emission reductions in 2010 from area sources were assigned to a 5 kilometer by 5 kilometer grid and those from point sources were assigned to a census tract for each quantified measure. The emission reductions for each quantified measure in each grid or census tract were then aggregated to a total of 19 sub-regions. The annual cost for each quantified measure (annualized capital and annual operating and maintenance expenditures) during the implementation period was then allocated to each sub-region according to its proportion of emission reductions.

Costs of SCAG transportation control measures will be financed by private and public funding. The private funding was allocated to the designated sectors according to the location of projects. The public funding was first allocated to each county according to the tax burden of each county and then to each sub-region according to its population share in the county. For area, on-road, and off-road sources, the annual cost of each control measure was allocated to each sub-region according to its share of emission reductions, which was aggregated from emission reductions at air quality grids.

As described in Chapter 3, the average annual costs of all quantified measures from 2002 to 2020 are projected to be $1.6 billion. Table 5-3 shows the projected cost share in each sub-region for all the quantified control measures by implementation jurisdiction. The Chino-Redlands area is projected to have the highest share (10%) of the cost for those measures that would be implemented by the AQMD. This is mainly due to Control Measures WST-01 (Emission Reductions from Livestock Waste) and WST-02 (Emission Reductions from Composting). The southern portion of Los Angeles County where the harbors and airports are located would share 50 percent of the cost for those measures that fall under the CARB and U.S. EPA jurisdiction. The Chino-Redlands area would have the highest share of the cost related to the transportation control measures. For all the quantified control measures as a whole, the southern portion of Los Angeles County would have an 19 percent share of the total cost, followed by the Chino-Redlands area (11%). For the 1997 AQMP, the eastern and northern portions of Los Angeles County were projected to have a relatively higher share of the costs than the rest of the communities.

TABLE 5-3
Cost Share by Jurisdiction by Sub-region for Quantified Measures

Sub-region	Jurisdiction						Total	
	AQMD		ARB & US EPA		SCAG			
	millions $	%	millions $	%	millions $	%	millions $	%
LA CO Burbank	$7	4%	$6	1%	$26	3%	$39	2%
LA CO San Fernando	14	7%	14	3%	55	6%	83	5%
LA CO West	12	7%	30	6%	44	5%	86	5%
LA CO Central	17	9%	11	2%	54	6%	82	5%
LA CO South Central	8	4%	7	1%	44	5%	60	4%
LA CO South	9	5%	254	50%	40	4%	303	19%
LA CO East	14	7%	15	3%	75	8%	104	6%
LA CO Southeast	11	6%	10	2%	59	6%	80	5%
LA CO Island	0	0%	0	0%	0	0%	0	0%
LA CO Beach	10	6%	22	4%	30	3%	62	4%
LA CO North	3	1%	5	1%	15	2%	23	1%
ORANGE CO North	4	2%	5	1%	36	4%	46	3%
ORANGE CO Central	12	6%	10	2%	66	7%	88	5%
ORANGE CO South	9	5%	12	2%	54	6%	76	5%
ORANGE CO West	10	6%	71	14%	53	6%	134	8%
Northwest Riverside	11	6%	10	2%	77	8%	98	6%
Other Riverside	9	5%	11	2%	53	6%	73	4%
Chino-Redlands	20	10%	17	3%	135	15%	172	11%
Other San Bernardino	6	3%	1	0%	12	1%	19	1%
Total	**$187**	100%	**$514**	100%	**$928**	100%	**$1,628**	100%

JOB IMPACTS BY SUB-REGION

The total projected employment for Los Angeles County is 5.92 million jobs in 2010 and 6.22 million in 2020 without the final 2003 AQMP. Orange County is projected to have 2.25 million jobs in 2010 and 2.48 million in 2020. Riverside and San Bernardino Counties are projected to have 0.95 and 1.02 million jobs in 2010 and 1.13 and 1.19 million jobs in 2020, respectively.

The distribution of job impacts (Table 5-4) by sub-region very much mirrors that of quantified benefits and costs. The western, central, and eastern (the San Gabriel Valley) portions of Los Angeles County are projected to have more jobs created than other sub-regions resulting from quantified clean air benefits. In terms of the job impact of quantified control measures, the majority of the jobs forgone are in the southern portion of Los Angeles County and the Chino-Redland area. Unlike other sub-regions, the non-urbanized San Bernardino County is projected to experience 1,380 jobs created instead due to the investments in the transportation control measures.

TABLE 5-4
Job Impacts by Sub-region for Quantified Benefits and Quantified Measures

	Quantified Benefits			Quantified Control Measures		
Sub-region	2010	2020	Average (2002-2020)	2010	2020	Average (2002-2020)
LA CO Burbank	2,708	2,907	2,093	-684	-778	-753
LA CO San Fernando	2,957	3,565	2,443	-960	-1,198	-1,088
LA CO West	8,370	8,992	6,422	1,030	-1,354	-399
LA CO Central	4,156	4,672	3,284	948	-1,680	-508
LA CO South Central	1,770	2,456	1,521	-643	-1,250	-834
LA CO South	1,878	2,668	1,682	-934	-4,680	-1,924
LA CO East	3,743	4,721	3,180	4,033	-1,210	434
LA CO Southeast	1,233	2,045	1,238	1,578	-1,431	-343
LA CO Island	6	7	5	-56	-74	-48
LA CO Beach	1,616	1,988	1,327	1,246	-987	-90
LA CO North	1,660	1,868	1,314	-228	77	-286
ORANGE CO North	1,748	1,986	1,381	351	-649	-232
ORANGE CO Central	3,561	3,917	2,770	-250	-1,285	-761
ORANGE CO South	3,958	4,392	3,069	-142	-849	-519
ORANGE CO West	3,038	3,336	2,345	-957	-3,886	-1,719
Northwest Riverside	2,258	3,709	2,115	1,579	-664	-566
Other Riverside	3,779	4,551	2,954	1,243	1,181	-537
Chino-Redlands	2,021	4,186	2,225	2,096	-4,022	-1,101
Other San Bernardino	610	1,019	569	1,393	4,169	1,380
Total	51,070	62,980	41,934	10,650	-20,570	-9,893

JOB IMPACTS BY RACE AND ETHNICITY

The job impacts discussed in this report represent the net change to the employment trend of an industry. This net change includes a mixture of new hires, layoffs/attrition from the existing work force, and a slowdown in projected job growth. When new hires are greater than layoffs, more jobs will be created. When the reverse is true, there will be jobs forgone. A dynamic economy must undergo such changes in order to grow and adjust to new conditions. These changes can increase productivity and promote greater competitiveness. Furthermore, these changes in the context of the final 2003 AQMP are necessary to improve the environment, which generates enormous benefits for the public.

The findings from an extensive literature review (Kletzer and Ong, 1994) as well as the Current Population Survey indicate that the chances of being displaced from a job are higher for African Americans and Hispanics than for non-Hispanic Whites and Asians. In addition, the re-employment rates are lower for African Americans and Hispanics than for Asians and non-Hispanic Whites. To account for that disparity this report makes adjustments, as necessary, to the information provided by the 1990 Census data on the distribution of jobs by ethnicity in a given 1-digit SIC industry.[1] The adjusted distributions were used for only

[1] The PUMS data from the 2000 census which would be the basis of the ethnic distribution of jobs by industry was scheduled to be released in April 2003, but was not available at the time when this report was produced.

those industries which show jobs forgone for the first five years of the final 2003 AQMP, since much of the near-term impacts may be generated through a combination of forgone growth and layoffs. The impacts in the more distant future tend to be deviations from projected job growth.

Table 5-5 shows the distribution of job impacts by industry and ethnicity for quantifiable clean air benefits and control measures, respectively. Between 2002 and 2006, it is projected that an average of 5,759 jobs would be created annually resulting from the clean air benefit alone. Job creation would rise to 54,855 jobs annually, on average, from 2007 to 2020. During both time periods, Whites would have a 55 percent share of the average annual jobs gained, followed by Hispanics (29 percent), Asians (9 percent), and African Americans (7 percent).

For the first 5 years of the final Plan, implementation of quantified control measures would result in 17,733 jobs to be created annually of which Whites would have a 54 percent share, followed by Hispanics (32 percent), Asians (8 percent), and African Americans (5 percent). From 2007 to 2020, quantified control measures are projected to have 19,761 jobs forgone annually, on average. The share of the 19,761 jobs forgone among different race and ethnicity groups is: 54 percent for Whites, 25 percent for Hispanics, 11 percent for Asians, and 9 percent for African Americans.

TABLE 5-5

Average Annual Job Impacts by Ethnicity by Industry for Quantified Clean Air Benefit and Quantified Measures

	Quantified Benefits									
	2002-2006					2007-2020				
Industry (SIC)	White	Black	Asian	Hispanic	Other	White	Black	Asian	Hispanic	Other
Agriculture (01-09)	19	2	4	38	0	268	22	55	528	3
Durables (24-15,32-39)	181	20	34	128	2	1629	176	309	1155	20
Non-Durables (20-30 ex 24-25)	106	11	26	141	1	942	100	232	1249	13
Mining (10-14)	3	0	0	1	0	18	2	1	6	0
Construction (15-17)	358	22	27	223	4	2579	158	192	1606	31
Transp. & Pub Util (40-49)	103	24	16	46	2	2204	519	334	979	37
Fin, Ins & Real Est. (60-67)	299	33	50	72	2	2253	245	377	544	16
Retail Trade (52-59)	640	62	135	409	7	5483	533	1158	3506	60
Wholesale Trade (50-51)	125	10	24	65	1	1391	108	272	720	14
Services (70-89)	1179	168	190	476	12	10157	1445	1637	4098	107
Government (91-97)	145	41	20	49	2	3026	857	419	1020	41
Total	3158	392	527	1647	35	29950	4166	4986	15412	341

TABLE 5-5
(Continued)

	Quantified Control Measures									
	2002-2006					2007-2020				
Industry (SIC)	White	Black	Asian	Hispanic	Other	White	Black	Asian	Hispanic	Other
Agriculture (01-09)	25	2	5	50	0	-200	-16	-42	-395	-2
Durables (24-15,32-39)	2628	284	499	1865	33	1122	121	213	796	14
Non-Durables (20-30 ex 24-25)	-14	-2	-3	-22	0	-479	-51	-118	-634	-7
Mining (10-14)	-8	-1	0	-3	0	-29	-3	-2	-9	0
Construction (15-17)	3615	222	269	2251	43	2713	167	202	1689	32
Transp. & Pub Util (40-49)	127	30	19	57	2	-1838	-433	-279	-817	-31
Fin, Ins & Real Est. (60-67)	456	50	76	110	3	-965	-105	-162	-233	-7
Retail Trade (52-59)	967	94	204	618	11	-3511	-342	-741	-2245	-38
Wholesale Trade (50-51)	-35	-4	-6	-22	-1	-1736	-135	-339	-898	-17
Services (70-89)	1943	276	313	784	20	-4065	-578	-655	-1640	-43
Government (91-97)	-50	-20	-6	-20	-1	-1687	-478	-233	-569	-23
Total	9654	931	1371	5666	111	-10675	-1852	-2156	-4956	-122

For the 1997 AQMP the job impact analysis was performed for the combined quantified clean air benefits and measures. It was projected that in the first five years of the 1997 AQMP, Whites would have a 57 percent share of the average annual jobs gained, followed by Hispanics (18 percent), African Americans (16 percent), and Asians (8 percent). After the first five years, the share of jobs created for Hispanics and African Americans would increase to 20 and 21 percent, respectively.

JOB IMPACTS ON HIGH- VERSUS LOW-PAYING JOBS

Occupations were grouped into five categories, lowest to highest, according to median weekly earnings. Table 5-6 shows the distribution of job impacts in 2010 and 2020 resulting from quantified clean air benefits and control measures, respectively, among various occupational wage groups. All the groups are projected to gain from cleaner air. For quantified control measures, all the groups except for the occupations in the lowest-paying job group would have job gains in 2010. In 2020 quantified measures would exert some slight job gains for Group 3 occupations and the rest of groups would have jobs forgone ranging from 0.15 percent to 0.31 percent of the baseline 2020 jobs. Group 3 occupations include secretaries, travel agents, mechanists of various types of equipment, dispatching workers, and so on. The occupations in each group are listed in Table B-1 of Appendix B.

TABLE 5-6

Employment Impacts by Occupational Wage Group for Quantified Clean Air Benefit and Quantified Measures

Group	Median Weekly Earnings	No. of Occupations	% Impact from Baseline			
			Clean Air Benefit		Control Measures	
			2010	2020	2010	2020
1	$223 - $346	18	0.53%	0.56%	-0.01%	-0.27%
2	$351 - $424	19	0.40%	0.74%	0.09%	-0.31%
3	$437 - $586	18	0.55%	0.59%	0.38%	0.04%
4	$597 - $671	18	0.42%	0.51%	0.08%	-0.15%
5	$694 - $1218	21	0.44%	0.49%	0.22%	-0.16%

IMPACTS ON DISPOSABLE INCOME

Without the 2003 AQMP, the real disposable income is projected to grow at an annual rate of 2.14 percent between 2002 and 2020.[2] Quantified clean air benefits of the draft final AQMP could increase the annual growth rate to 2.18 percent. Per capita real disposable income (total real disposable income divided by population) would increase slightly by $19.6 per year. On the other hand, the quantified measures would lower the projected growth rate of the real disposable income from 2.14 to 2.11 percent annually. This would result in a decrease in per capita real disposable income by $22.9.

The increase in the real disposable income resulting from quantified clean air benefits more than outweighs its decrease due to the implementation of quantified measures. The absolute magnitude of decrease in per capita real disposable income resulting from quantified control measures is greater than that of increase due to quantified clean air benefits because of the differences in population growth rates. The annual population growth rate from 2002 to 2020 is projected to be 1.35 percent with clean air benefits alone as opposed to the baseline annual growth rate of 1.31 percent. Implementation of quantified control measures is projected to lower the annual population growth rate to 1.29 percent relative to the 1.31 percent baseline rate.

IMPACTS ON PRICE INDEX BY INCOME

The REMI model develops price indexes of consumption goods for households in five income groups by comparing prices of those goods between the four-county region and the rest of the United States. The draft final 2003 AQMP is projected to result in increases in the price of consumption goods (those goods identified in the annual Consumer Expenditure Survey by the Bureau of Labor Statistics). Table 5-7 shows the projected percentage change in the price of consumption goods by income group for quantified clean air benefits and control measures, respectively, in the years 2010 and 2020.

[2] The real disposable income for the four county area is projected to be $328 billion in 2002 and $481 billion in 2020. Disposable income is the sum of the incomes of all the individuals in the economy after all taxes have been deducted (Baumol and Blinder, 1982).

The change herein is of the baseline index of consumption goods. The price of consumption goods is projected to decrease by less than one-third of a percent in 2010 and 2020 due to the attainment of the clean air standards. The impact does not vary from one income group to another. Implementation of quantified control measures is projected to increase the price of consumption goods from 0.24 to 0.25 percent. The projected increase in the price is due to the pass-through of additional control costs by industries that are affected by a number of control measures.

TABLE 5-7

Impacts on the Price of Consumption Goods for
Quantified Clean Air Benefit and Quantified Measures
(percent of baseline)

	Clean Air Benefit		Control Measures	
Household Income	2010	2020	2010	2020
1st Quintile	-0.32%	-0.18%	0.25%	0.26%
2nd Quintile	-0.31%	-0.18%	0.25%	0.25%
3rd Quintile	-0.31%	-0.18%	0.24%	0.25%
4th Quintile	-0.31%	-0.18%	0.24%	0.24%
5th Quintile	-0.31%	-0.18%	0.24%	0.24%

SUMMARY

Implementation of the 2003 AQMP is projected to result in air quality improvements sufficient to attain the air quality standards by 2010 throughout the Basin. The air quality modeling results have, however, shown the greatest relative improvements and air quality benefit in the eastern portion of the Basin. The Chino-Redlands area is shown to have the greatest share of the monetary value of these improvements. A demographic analysis of the 2000 census showed that 45 percent of the population there is Hispanics and 36 percent Whites. The minority population increased from 45 percent in the 1990 census to 64 percent in the 2000 census.

The attainment of the air quality standards in 2010 depends on a full implementation of control measures, as proposed in the 2003 AQMP. The costs of these measures will spread throughout various communities. The cost of quantified control measures that represent 30 percent of the total emission reductions towards clean air would exert a relatively higher share on the southern portion of Los Angeles County and the Chino-Redlands area than the rest of the communities.

All the 19 sub-regions are projected to have additional jobs created from cleaner air. All the ethnic groups are expected to have job gains as a result. The combined share of Whites and Hispanics in job gains is projected to be 84 percent. Implementation of quantified control measures would also result in additional jobs to be created between 2002 and 2006 of which Whites are projected to have a 54 percent share and Hispanics would have a 32 percent share. In later years (2007 to 2020), these measures would result in an average of 19,761 jobs forgone annually of which the share of Hispanics is 25 percent and that of Whites is 54 percent.

Job gains from cleaner air would vary slightly among five wage groups comprised of 94 occupations. In 2010, it is projected that all five groups but the lowest-paying group would experience job gains from quantified control measures. In 2020, all five groups but the middle group would face jobs forgone. On the other hand, there is no significant difference in impacts expected for high- versus low-paying jobs. There is no significant difference in impacts on the price of consumption goods from one income group to another. These findings are only preliminary and require further evaluation during individual rule adoption hearings.

For the 1997 AQMP where the analysis of quantified measures and benefits was combined, it was projected that all ethnic groups would be expected to have a net job gain. No significant differences were identified in impacts on high- versus low-paying jobs, or on the price of consumption goods from one income group to another.

Implementation of the unquantified measures could result in employment impacts on ethnic groups. A detailed analysis cannot, however, be performed on unquantified measures until they are fully quantified relative to their costs. The distribution of job impacts on ethnic groups resulting from quantified measures and benefits needs to be further explored with the use of additional and more recent data. The AQMD will further examine these issues in future efforts.

Additional surveys on affected groups and communities need to be developed to better understand the detailed job impacts. Furthermore, additional tools need to be developed relative to presenting socioeconomic and air quality data geographically. Chapter 8 has a more detailed description of these proposed future enhancements to the socioeconomic analysis.

CHAPTER 6

IMPACTS ON COMPETITIVENESS

INTRODUCTION

Regional economic competitiveness depends on various factors including business costs, workforce quality, public infrastructure, quality of life, and the regulatory environment. Air quality regulations directly affect business costs, quality of life and the regulatory environment. Specifically, the 2003 AQMP will affect regional economic competitiveness in two ways: (1) by imposing costs on business as a result of pollution control strategies; and (2) by improving the region's quality of life by reducing air pollution.

It is not possible at this time to quantify the costs associated with every control measure and benefits associated with every effect of clean air. Of all the intended emission reductions for cleaner air, only 30 percent can be quantified. Costs for the other measures are not available at this time because control methods, control efficiencies, emission reductions, or costs of control technologies are not presently known. The REMI model, used to analyze potential impacts of the 2003 AQMP, projects possible impacts on product prices, profits, exports, and imports based upon the input of spending and annualized costs for each control measure and benefit data for each effect of clean air. The reliability of such projections is dependent upon the validity of the input. The AQMD staff believes that it would be inappropriate to make assumptions relative to cost impacts on product prices, profits, exports, and imports for unquantified measures. The analysis contained herein, therefore, considers only those measures and benefits for which quantification is available.

REGION’S SHARE OF U.S. JOBS

Table 6-1 shows the impacts of quantified benefits and measures on the region's share of national jobs. As the air gets cleaner, the four-county region is predicted to gain a larger share of total national jobs through 2020. The increase ranges from 0.01 to 0.03 percent, as compared to the baseline projection without the AQMP. The similar trend and magnitude are also observed for the region’s share of manufacturing jobs in the nation.

As investments in infrastructure and pollution control equipment or devices occur in the beginning of a control measure’s implementation period (e.g., the year 2006), the region will continue its trend of having a larger share of the total national jobs and national manufacturing jobs. However, as the costs of implementing these measures are continually amortized over the project period, fewer jobs would be created, thus resulting in a smaller increase in the region’s share of national jobs (e.g., the year 2010). Over time, this share becomes even smaller as compared to the baseline projection without the AQMP (the year 2020).

Due to the extremely small values presented here, either the quantified benefits or the quantified measures are not expected to result in discernible differences in the four-county region's share of national jobs over the analysis period.

TABLE 6-1

Impacts on Region's Share of U.S. Jobs for Quantified Benefits and Quantified Measures (percent)

	Percent Share of U.S. Jobs for Quantified Benefits			Percent Share of U.S. Jobs for Quantified Measures		
	2006	2010	2020	2006	2010	2020
Total Jobs						
With Quantified Benefits	5.47	5.57	5.67			
With Quantified Measures				5.49	5.55	5.62
Without 2003 AQMP	5.47	5.54	5.63	5.47	5.54	5.63
Difference	0.01	0.03	0.03	0.02	0.01	-0.01
Manufacturing Jobs						
With Quantified Benefits	5.44	5.35	5.08			
With Quantified Measures				5.50	5.36	5.04
Without 2003 AQMP	5.44	5.32	5.04	5.44	5.32	5.04
Difference	0.01	0.03	0.03	0.07	0.04	0.00

Some of the numbers are rounded off.

PRODUCT PRICES AND PROFITS

Relative to product prices, the REMI model assumes that national industries absorb additional production costs, while regional industries pass these costs on to consumers (all users of products). Industries with more than 50 percent of its sales outside of a region are national and those with more than 50 percent of its sales inside of a region are regional. The impact of additional production costs on national industries will be changes in profits, but the impact on regional industries will be changes in selling prices. The REMI model calculates a composite index of product prices and profits for industries in the four-county region relative to those in the rest of the United States. An index of 1 indicates that the product prices and profits in the region are relatively the same as those in the rest of the United States. An index of product prices above or below 1 means that product prices in the four-county areas are higher or lower, respectively, than those in the rest of the United States. The same is said of profits.

Table 6-2 shows the percentage difference in product prices relative to the baseline for regional industries, respectively, for quantified benefits and measures in 2010 and 2020. Cleaner air would result in a decrease in product prices for all industries. The trucking and warehousing industry (SIC 42) would have the highest reduction in its product price due to congestion relief. Implementation of quantified measures, on the other hand, would increase product prices for the majority of sectors. The industry of other transportation (SICs 44, 46-47) where water transportation belongs would face the higher increase in its product price, which is approximately 10 percent of the baseline price index in 2020. This is due to the requirements in a few marine measures on federal sources.

TABLE 6-2

Impacts on Product Prices of Regional Industries Relative to Those in U.S. for Quantified Benefits and Measures (percent of sales)

Industry (SIC)	Quantified Benefits 2010	Quantified Benefits 2020	Quantified Measures 2010	Quantified Measures 2020
Stone, Clay, etc. (32)	-1.32%	-0.81%	0.46%	0.37%
Printing (27)	-0.52%	-0.34%	0.34%	0.25%
Petroleum Products (29)	-0.77%	-0.42%	0.50%	0.56%
Mining (10,12-14)	-0.14%	-0.01%	0.30%	0.17%
Construction (15-17)	-0.51%	-0.30%	0.53%	0.27%
Railroad (40)	-0.31%	-0.26%	0.36%	0.60%
Trucking (42)	-10.62%	-6.30%	0.82%	0.60%
Local/Interurban (41)	-0.32%	-0.23%	0.24%	0.17%
Air Transp. (45)	-0.37%	-0.30%	0.47%	0.79%
Other Transp. (44,46-47)	-0.29%	-0.21%	3.31%	10.01%
Communication (48)	-0.23%	-0.15%	0.30%	0.18%
Public Utilities (49)	-0.28%	-0.16%	0.40%	0.28%
Banking (60)	-0.40%	-0.26%	0.27%	0.16%
Insurance (63,64)	-0.19%	-0.14%	0.22%	0.13%
Credit & Finance (61-62,67)	-0.24%	-0.16%	0.26%	0.14%
Real Estate (65)	0.21%	0.41%	0.05%	-0.14%
Eating & Drinking (58)	-0.32%	-0.23%	0.22%	0.15%
Rest of Retail (52-57,59)	-0.17%	-0.13%	0.21%	0.12%
Wholesale (50-51)	-0.19%	-0.15%	0.21%	0.13%
Personal Serv. & Repair (72,76)	-0.27%	-0.18%	0.25%	0.14%
Private Household (88)	-0.03%	-0.16%	0.16%	0.08%
Auto Repair/Serv. (75)	-0.37%	-0.24%	0.25%	0.18%
Misc. Busi. Serv. (73)	-0.25%	-0.16%	0.25%	0.13%
Amuse. & Recreation (79)	-0.33%	-0.19%	0.24%	0.13%
Motion Pictures (78)	-0.39%	-0.24%	0.27%	0.17%
Medical (80)	-0.13%	-0.09%	0.19%	0.13%
Misc. Prof. Serv. (81,87,89)	-0.25%	-0.16%	0.27%	0.12%
Education (82)	-0.14%	-0.04%	0.22%	0.09%
Non-Profit Org. (83-84,86)	-0.11%	-0.05%	0.20%	0.09%
Agri/Forest/Fish Serv. (07-09)	-0.19%	-0.17%	0.81%	0.87%

Table 6-3 shows the impact of the AQMP on profits for national industries, respectively, for quantified benefits and measures. All industries shows increased profits as air gets cleaner. The additional cost of doing business from the quantified measures would reduce the profits of industries. On average, profits for the majority of national industries will decrease by less than one-half percent of the baseline profit index. The relatively higher profit reduction in the leather industry is due to a higher absolute cost for this industry relatively to its representation in the four-county economy as the costs for Control Measure TCM-1B (Transit and Systems Management) were shared among all the industries according to their relative representation.

TABLE 6-3

Impacts on Profits of National Industries Relative to Those in U.S. for Quantified Benefits and Measures (percent of sales)

Industry (SIC)	Quantified Benefits		Quantified Measures	
	2010	2020	2010	2020
Lumber (24)	0.59%	0.36%	-0.36%	-0.29%
Furniture (25)	0.26%	0.18%	-0.30%	-0.21%
Primary Metals (33)	0.60%	0.37%	-0.31%	-0.20%
Fabricated Metal (34)	0.36%	0.24%	-0.28%	-0.19%
Industrial Machinery & Equipment (35)	0.12%	0.09%	-0.17%	-0.11%
Elect. Equipment (36)	0.20%	0.15%	-0.21%	-0.12%
Motor Veh. (371)	0.49%	0.30%	-0.24%	-0.18%
Rest of Transp. Equip. (372-379)	0.14%	0.10%	-0.23%	-0.17%
Instruments (38)	0.25%	0.17%	-0.26%	-0.15%
Misc. Manuf. (39)	0.42%	0.28%	-0.29%	-0.22%
Food (20)	0.36%	0.22%	-0.22%	-0.19%
Textiles (22)	0.35%	0.23%	-0.30%	-0.25%
Apparel (23)	0.27%	0.18%	-0.32%	-0.29%
Paper (26)	0.57%	0.37%	-0.41%	-0.25%
Chemicals (28)	0.73%	0.47%	-0.35%	-0.24%
Rubber (30)	0.62%	0.38%	-0.28%	-0.21%
Leather (31)	0.59%	0.40%	-0.63%	-0.51%
Hotels (70)	0.45%	0.32%	-0.29%	-0.21%

IMPORTS AND EXPORTS

Table 6-4 summarizes the overall impact of quantified measures and benefits, respectively, on the region's exports and imports relative to the baseline projections. Cleaner air will increase quality of life for residents and make the area more attractive to live and competitive for businesses. As more people migrate to the area, the additional supply of labor would dampen real wage rates, thereby lowering production costs and product prices or increasing profits. As a result, industry production is projected to rise relative to its baseline condition. The increased production would translate to increases in exports and in satisfying the additional demand from local residents and other industries. Part of the demand increase is projected to be fulfilled by increases in imports.

Implementation of quantified measures is projected to increase output production in the region in beginning years as investments are pouring in (2005 and 2010). This trend would be reversed in later years as the regulated community faces the impact of additional cost of doing business. Demand for additional investments and other goods and services would be satisfied mostly by increases in imports in early years. In later years, demand for goods and services would decline because of the current and carry-over effects of higher product prices resulting from pass-through of additional control costs by affected regional industries and lower profitability of national industries. The similar trend is observed for exports too. The dampened demand would also result in a reduction in imports.

It should be noted that the magnitude of all of these directional changes is relatively small when compared with the overall size of the four-county economy. For example, exports are projected to decrease by 0.18 percent of the baseline exports in 2020 resulting from implementing quantified measures.

TABLE 6-4

Impacts on Imports and Exports for Quantified Benefits and Measures

	Quantified Benefits				Quantified Measures			
	2005	2010	2015	2020	2005	2010	2015	2020
Demand*	+	+	+	+	+	+	-	-
Imports	+	+	+	+	+	+	-	-
Self Supply*	+	+	+	+	+	-	-	-
Exports	+	+	+	+	-	-	-	-
Ouput (Production)	+	+	+	+	+	+	-	-
Selling Price	-	-	-	-	+	+	+	+
Manufacturing Profit	+	+	+	+	-	-	-	-

A plus or minus sign means that there is an increase or decrease in the value of that economic variable resulting from the quantified benefits and measures of the final 2003 AQMP relative to the baseline economic activities.

*Include changes in demand due to changes in control requirements.

SUMMARY

The results of this chapter show that the quantified measures and benefits of the draft final 2003 AQMP are not expected to result in discernible differences in the four-county region's share of national jobs. For the majority of sectors, the impact on product prices is projected to be less than one-half of one percent of the baseline index of product prices and the impact on profits is projected to be less than one-half of one percent of the baseline index of profits. The impact on imports and exports is small as well.

The competitive analysis focuses on the impact on various sectors of the local economy. Individual control measures could result in impacts on individual companies. Competitiveness at the company level will be further considered during individual rulemaking procedures.

The actual effects of the draft final 2003 AQMP (including unquantified measures and benefits) on regional competitiveness could vary from the projected effects of quantified measures and benefits for several reasons. First, the analysis assumes that all control costs are "extra" costs when compared to air pollution control costs in other regions. This ignores the fact that competing regions tend to follow the AQMD's lead and adopt control measures with objectives similar to those proposed in the AQMD or at a minimum have some level of control with its consequent costs. For example, a number of eastern states have adopted the California vehicle exhaust standards. Furthermore, a number of on-road and off-road measures reflect implementation of national standards on mobile sources. Second, the socioeconomic analysis underestimates the benefits from clean air that would increase regional attractiveness. Third, the AQMD is continuing to implement special programs to foster economic competitiveness in the region. These programs cover two broad strategies:

(1) Reducing costs of meeting air quality mandates through the use of market incentive approaches and educational programs on consumer awareness; and

(2) Business assistance programs, such as permit streamlining programs, small business assistance programs, economic development and business retention programs, and air quality assistance funding.

Finally, costs of unquantified measures may also affect competitiveness if they are implemented solely in the region. The impact of proposed air quality regulations on competitiveness will be examined during the rulemaking process for each proposed rule. Chapter 8 has a more detailed description of proposed enhancements to future assessments.

CHAPTER 7

ASSESSMENT OF CEQA ALTERNATIVES

INTRODUCTION

The California Environmental Quality Act (CEQA) requires that the AQMD propose alternatives to the 2003 AQMP. These alternatives include a range of reasonable options that could feasibly meet the project objective. This chapter addresses the socioeconomic impacts of the alternatives proposed in the final EIR.

DESCRIPTION OF ALTERNATIVES

The final Program EIR (PEIR) for the 2003 AQMP identifies the following five alternatives to the proposed Plan:

No Project Alternative (1997/1999 AQMP)

This alternative is based on the 1997/1999 State Implementation Plan and excludes all the measures that have been adopted. The net effect of the No Project alternative would be a continuation of the existing 1997/1999 AQMP as approved by the California Air Resources Board (CARB) and U.S. EPA.

Less NOx Reduction Alternative

This alternative assumes no NOx emission reductions from U.S. EPA's on- and off-road mobile sources. Compared to the final Plan, this alternative excludes possible long-term federal emission reduction approaches in the area of jet aircraft, harbor craft and ocean-going ships, and on-road heavy duty trucks (part of Tier II of Long-term Measure). Additionaly, this alternative excludes some NOx sources in Tier I of Long-term Measure.

More VOC and Less NOx Reduction Alternative

This alternative is the same as the Less NOx Reduction alternative in terms of exclusion of federal on- and off-road sources, but requires an additional 60 tons of VOC reductions from Tier II of Long-term Measure. These additional VOC emission reductions are due to a potentially lower carrying capacity for VOC in the year 2010.

More VOC Reduction Alternative

This alternative has a more aggressive control of VOCs towards the one-hour and 8-hour ozone and 24-hour and average annual PM2.5 standards, in addition to the 2003 AQMP. All the additional emission reductions (60 tons per day) would be reflected in Long Term Tier II Measure, of which one-third would come from the AQMD sources and the remaining two-thirds from the CARB's on- and off-road mobile sources.

Least Toxics Alternative

In addition to the 2003 AQMP, this alternative includes additional controls on heavy-duty vehicles, ships, and agricultural pumps in order to achieve lower toxic emissions. It was assumed that 50 percent of heavy-duty vehicles with model years 1994 and beyond would be retrofitted with diesel particulate filters between 2005 and 2010. Seventy-five percent of the docking ships were assumed to use on-shore power and 75 percent of stationary agricultural pumps would be electrified between 2005 and 2010.

AIR QUALITY BENEFITS OF ALTERNATIVES

This socioeconomic analysis compares the air quality benefit resulting from implementation of the final Plan with respect to the baseline "no control" scenario for ozone, PM10, and visibility. The 2003 AQMP has been demonstrated to attain the federal PM10 standards in 2006 and the federal ozone standard in 2010. The same can be said of all other alternatives except for the No Project Alternative. The 2003 AQMP along with all other alternatives is projected to attain the state visibility standard in 2010.

COMPARISON OF SOCIOECONOMIC IMPACTS

Table 7-1 compares the direct costs, direct air quality benefits, and job impacts of the various alternatives to the draft final 2003 AQMP. The monetary cost and benefit analysis includes both quantified and unquantified measures and quantified benefits. Since the socioeconomic assessment is performed on an annual basis, no job analysis can be performed for the unquantified control measures. The quantified measures represent only 30 percent of the intended emission reductions for clean air. Therefore, the job analysis for the cost side in Table 7-1 represents the job impacts from implementing only 30 percent of the emission reductions. The clean air benefit in Table 7-1, on the other hand, depicts the air quality benefit of all the intended emission reductions for attainment. Therefore, its associated job impact includes the air quality benefit of all the emission reductions. All the alternatives as well as the draft final Plan use the same estimate for the congestion relief benefit and SCAG transportation control measures.

TABLE 7-1

Average Annual Impacts of AQMP Alternatives versus Draft Final 2003 AQMP

Alternatives	Costs		Quantified Benefits	
	Millions of 97 Dollars	Jobs*	Millions of 97 Dollars	Jobs
Draft Final 2003 AQMP	$3,249	-9,893	$6,639	41,934
No Project	1,261	-1,736	5,137	40,492
Less NOx Reduction	2,757	-7,280	5,891	41,781
More VOC/Less NOx Reduction	3,043	-7,280	6,417	41,795
More VOC Reduction	3,535	-9,893	7,254	42,487
Least Toxics	3,498	-12,690	7,233	42,554

*Reflect only the impacts of quantifiable measures.

All the alternatives and the draft final 2003 AQMP show higher air quality benefits than the costs which are necessary to get there. However, uncertainty regarding the cost estimation for the unquantified measures exists because this portion of the cost is based on the average cost of quantified measures and only 30 percent of emission reductions belong to the quantified measures. The No Project alternative does not attain the air quality standards and thus shows the least air quality benefit ($5.1 billion). The Less NOx Reduction alternative has the least air quality benefit ($5.9 billion) and the More VOC Reduction alternative has the highest air quality benefit ($7.3 billion) among all the alternatives attaining the federal and state air quality standards. Sixty-one percent of the incremental benefit between the More VOC Reduction alternative and the final 2003 AQMP is due to the visibility improvement. At the sub-region level, the visibility aesthetic benefit in the non-urbanized San Bernardino County under the More VOC Reduction alternative is projected to be 88 percent higher than that under the final 2003 Plan. Table 7-2 shows the distribution of quantified benefits for all the alternatives among different benefit categories.

TABLE 7-2
Distribution of Average Annual Quantified Benefits by Category for All Alternatives
(millions of 1997 dollars)

Alternatives	Total	Health	Visibility	Congestion Relief	Material	Crop Yield
Draft Final 2003 AQMP	$6,639	$2,579	$1,940	$2,038	$63	$18
No Project	5,137	1,856	1,186	2,038	40	17
Least NOx Reduction	5,891	2,064	1,717	2,038	54	18
More VOC/Less NOx Reduction	6,417	2,446	1,853	2,038	61	19
More VOC Reduction	7,254	2,813	2,314	2,038	70	19
Least Toxics	7,233	2,681	2,407	2,038	89	18

In terms of monetary costs, the No Project alternative is the least expensive because it contains the fewest control measures. The difference between the draft final 2003 AQMP and the More VOC Reduction alternative resides only in the unquantified Tier II long-term strategy. The difference between the draft final 2003 AQMP and the Least Toxics alternative is the additional control on heavy-duty vehicles, ships, and agricultural pumps for the latter. The cost of such additional control is fully quantified. The difference between the draft final 2003 AQMP and the Less NOx Reduction alternative is the lesser cost employed on on- and off-road mobile sources which is reflected in both quantified and unquantified (long term Tier I strategy) measures for this alternative.

In terms of the job impact, cleaner air would foster continued growth of the local economy as shown in the last column of Table 7-1. Implementation of quantified control measures, on the other hand, would slow down the economy mainly due to the additional cost of doing business employed on the regulated community. Among all the alternatives that are projected to meet the air quality standards, the Least Toxic alternative would produce the highest number of jobs forgone (but it also has the highest incremental benefit relative to incremental cost when compared with the draft final 2003 AQMP). The job impacts of the cost and benefit sides cannot be compared with each other because the former reflects only 30 percent of the total emission reductions while the latter includes all the emission reductions.

SUMMARY

The No Project alternative would not reach the attainment of air quality standards. All other alternatives display fewer variations in monetary costs than in monetary benefits. Except for the No Project alternative, the job impact of quantified measures shows more variations among alternatives than that of quantified benefits.

CHAPTER 8

RECENT REFINEMENTS AND FUTURE ACTIONS

INTRODUCTION

The socioeconomic report for the 1997 AQMP identified key areas for future refinements. This chapter discusses the progress in these refinements. Despite the use of a variety of tools and the inclusion of these refinements in assessing the socioeconomic impacts of the 2003 AQMP, the tools and refinements are not capable of addressing all of the previously identified public policy questions. The assessment of some of these issues requires linking information from multiple fields and data that is currently unavailable. Overcoming these constraints will require interdisciplinary research, data collection, and a combination of approaches. The AQMD plans to continue to work with the Scientific, Technical and Modeling Peer Review Advisory Group (STMPRAG), the Ethnic Community Advisory Group (ECAG), the Local Government and Small Business Assistance Advisory Group (LGSBAAG), and other interested parties to improve its socioeconomic assessments.

Alternative approaches to issues not able to be addressed in the 2003 AQMP will be pursued for use in the socioeconomic assessments of future AQMP revisions. Described below are recent refinements and alternative approaches/issues that need to be further explored. The AQMD will also explore the potential to jointly fund these projects with other agencies and the business community.

BENEFITS OF CLEAN AIR

The socioeconomic assessment of the 2003 AQMP makes significant progress in quantifying several benefits of improved air quality including congestion relief, visibility improvements, and crop yields.

Congestion relief benefit has been expanded to include benefits from reduced vehicle hours traveled (VHT) in addition to reduced vehicle miles traveled (VMT). VHT benefit was divided into business and commute trips. The visibility benefit assessment approach is also updated with the most recent data and developments in the economic field. The Beron et al. (2001) study used sales prices of owner-occupied single-family homes between 1980 and 1995 as well as socioeconomic and housing characteristics of these homes and visibility data at the census tract level to arrive at a willingness to pay (price of visibility) for visibility. The research was performed for the counties of Los Angeles, Orange, Riverside, and San Bernardino. The willingness to pay was shown to be related to the percentage of college degree of people 25 years or older, net income (household income minus housing cost), and visibility (in miles) at each location. Members of the LGSBAAG raised the concern about the strength of association between the variables of college degree holders and net income with the willingness to pay for visibility.

The agricultural benefit analysis has been significantly refined with the specific location of the crops and acreage. This information is spatially joined with the Public Land Survey (PLS) grid system (1 mile by 1 mile) and the air quality modeling grid system (5 kilometer by 5 kilometer) to estimate the additional crop yields from cleaner air at the air quality grid level.

Except for the material benefit assessment, all other benefit assessments were performed either at the air quality grid level or the sub-region level which is in sharp contrast to the past approach where more aggregated air quality data at the county or basinwide level was utilized. This new approach provides finer details on clean air benefits geographically.

Progress on the health benefit assessment of future AQMPs and other AQMD actions will continue. The interpretation of assessments will become increasingly important as more dimensions are added to quantitative and qualitative measurements of health effects. Previous refinements suggested in the 2003 AQMP that may be implemented in future AQMPs include the consideration of changes in life expectancy, the number of premature deaths, the separate effects of different pollutants to help examine the correlation between pollutants, and the study of at-risk populations to reduce potential double counting of health effects of pollutants and to identify significant pollutant thresholds for health impacts. The AQMD also intends to fund future research examining a possible linkage between smog and brain cancer and to establish an asthma and air pollution research center.

COSTS OF CLEAN AIR

Thirty-one short-term control measures and some portion of long-term measures in the draft final 2003 AQMP (representing 30 percent of the total intended emission reductions) were quantified with costs. For each quantified measure in the 2003 AQMP, the refined cost estimation approach began at the facility level for point sources and at the air quality modeling grid level for area, on-road, and off-road sources. The cost assessment for transportation control measures was performed at the sub-region level. This approach directly links costs to emission sources and thus reduce the uncertainty in cost allocation.

Additional measures will be quantified as affected sources are specifically identified and control technology becomes known. The AQMD will be working with the CARB and U.S. EPA to help advance technology in the unknown area. Furthermore, the AQMD is exploring the expansion of its regulatory program to include mobile sources pending additional legal authority.

Projected costs of control measures are very often different from the actual costs. Actual costs are generally thought to be lower than the projected costs due to cost reductions resulting from innovative technologies. In addition, the AQMD has revised compliance dates as necessary for rules where the projected technology is unavailable for implementation. However, several members of the STMPRAG have suggested the possibility that as the AQMD becomes closer to its attainment goals for various pollutants the cost in achieving the final increment towards attainment might actually result in higher costs than projected. It is also not clear whether the costs associated with maintaining attainment of various pollutants will be reflective of the currently projected costs. The AQMD has been closely working with the CARB to study the actual costs of three AQMD rules.

To increase regulatory flexibility, the AQMD has proposed alternatives to command-and-control regulations. These alternatives include a mitigation fee type program for federally mandated sources and an emission fee program for port-related vehicles. The AQMD is committed to quantifying the costs of these alternatives and identifying which groups might be affected disproportionately in future AQMPs.

DISTRIBUTIONAL IMPACTS

The REMI model, which is used for assessing direct and indirect impacts on various entities on the local economy has been refined from a county-based geography to a sub-county geography. The division into 19 sub-regions is to further align costs of control measures, benefits of clean air, and macroeconomic impacts at a smaller geographic level. The linkage between emissions, ambient concentration of pollutants, and the 2000 Census data provides a baseline socioeconomic profile of affected sources as well as economic impacts of emission reductions on the local economy. This effort also represents integration of several disciplines in terms of data alignment. For example, emission and pollutant concentration data is compiled more towards geographic divisions than the socioeconomic data which is displayed according to political boundaries.

Additional efforts have been made to improve the analysis of impacts upon specific industries, small businesses, and minority owned businesses. Much of this is necessitated by the nature of the rules being implemented that tend to be more specialized in nature and to focus on smaller and previously unregulated industries.

To this end, the AQMD has worked with BBC Research and Consulting to develop a methodology for conducting facility based and post rule assessments. Two case studies on the woodworking and dry cleaning industries were performed. Facility based assessments can be used during the rule development process to better analyze the effect of a proposed regulation on specific segments of an industry. Facility based assessments that use time series data can establish historical perspective and future outlook of affected industries across geographical areas.

The AQMD is also looking into methods of assessing environmental justice concerns where particular areas or sub-populations have experienced a disproportionate burden of adverse air quality impacts. These approaches will continue to be utilized, as necessary, in the rulemaking and post-rulemaking process.

COMPETITIVENESS

Local firms that sell products in national or international markets have to compete with firms located in less polluted regions or those subject to fewer regulations. Existing tools for the analysis of competitiveness focus on the impacts at the national or macroeconomic level. Impacts at this level are normally small, statistically insignificant, or inconclusive. Since the 1994 AQMP, the AQMD has focused more on examining profiles of companies affected by individual rules to supplement the macro-level analysis. The profiles include annual sales of average firms, the total number and size of affected firms, and the number of employees and profit margins of affected firms. This micro-level analysis is possible in those instances where affected companies can be specifically identified and reliability of data on their profile can be verified.

The AQMD is preparing to develop additional parameters for evaluating competitiveness impacts. Refinements suggested in the 2003 AQMP include analyzing the share of locally-produced goods in total sales, firms moving out of the area or going out of business, changes in profits, the use of substitute products, and changes in the pattern of industrial organizations. This approach will help examine the extent to which clean technology induces innovation that creates new economic opportunities and thus increases competitiveness in the region.

ENHANCEMENTS

The 1997 AQMP socioeconomic analysis identified actions that would further enhance the ability to quantify and evaluate the benefits and costs of the proposed Plan. This socioeconomic analysis has accomplished several of these actions and identified others for still future assessment. Table 8-1 summarizes enhancements that have been accomplished and those still recommended for further action in the assessment of the 2006 AQMP.

Future enhancements on health benefit assessments would include the identification of individual pollutant effects and of significant thresholds for health impacts. The STMPRAG has suggested that the air quality, land use, and socioeconomic models be merged to facilitate impact assessments for additional parameters. The greater use of GIS to perform more sophisticated spatial analyses is proposed for assessing distributional impacts. Building a time series data base and timely converting to a North American Industrial Classification System (NAICS) would enhance the assessment on specific segments of an industry and facilitate the alignment with published governmental statistics.

Finally, the REMI model used to assess the economic impacts of the 2003 AQMP may be enhanced to include the effects of previous regulations and the differential effect of regulations on small businesses.

TABLE 8-1

Enhancements Achieved and Proposed for Future Action

Topic	Achieved	Proposed for Future
Benefit **Quantitative & Qualitative Benefit Assessments**	• Quantify benefits from reductions in vehicle hours traveled. • Assess benefits for greater geographical details • Update the visibility benefit estimate. • Establish air quality research center to further assess health impacts.	• Estimate changes in life expectancy (1997).[1] • Separate multiple pollutant effects (1997). • Examine at-risk population (1997).
Cost **Evaluation of Costs and Flexible Regulatory Approaches**	• Quantify costs at source locations. • Continue the use of the mitigation fee and emission fee concepts.	• Examine differences between command-and-control regulations and pricing or subsidies (1994).[2] • Work with the CARB to examine post rule costs.
Distributional Impacts **Geographic Information System (GIS)**	• Develop facility based assessment to analyze specific segments of affected industries. • Analyze macroeconomic impacts at sub-county level for differential impacts.	• Produce more detailed sub-region analyses through GIS. • Merge air quality, land use, and socioeconomic models.
Competitiveness **Impact of Regional Regulations on Competitiveness**	• Use firm and industry profiles to perform segmentation study of an industry.	• Assess the impact of innovation on competitiveness. (1994) • Build time series database for trend analysis. • Convert to the North American Industrial Classification System (NAICS) for comparable statistics.

[1]Origionally proposed in the 1997 AQMP Socioeconomic Report.
[2]Origionally proposed in the 1994 AQMP Socioeconomic Report.