

The Benefits

of Meeting Federal Clean Air Standards in the
South Coast and San Joaquin Valley Air Basins

Jane V. Hall, Ph.D.
Victor Brajer, Ph.D.
California State University
Fullerton, CA
Frederick W. Lurmann, M.S.
Sonoma Technology, Inc.
Petaluma, CA
November 2008

Research funded by the William and Flora Hewlett Foundation

EXECUTIVE SUMMARY

OVERVIEW

There has long been a tug-of-war about the cost of protecting public health by reducing life-threatening pollution. A central objective of this study is to assess the cost of the status quo, and the health and related economic benefits that will result from achieving the federal ozone and $PM_{2.5}$ standards in the South Coast and San Joaquin Valley air basins.

Both the federal government and California have set health-based air quality standards for ozone and fine particle ($PM_{2.5}$) pollution because there is wide concurrence that these pollutants pose a serious risk to health. Ozone pollution's effect ranges from premature death to school absences and hospitalizations, to symptoms that limit normal daily activity. Exposure to fine particles is tied to a range of effects from premature death and the onset of chronic bronchitis to loss of work days and respiratory symptoms.

Despite the widespread consensus on the danger of these pollutants and the necessity of the health-based standards, the South Coast and San Joaquin Valley air basins of California have air pollution levels that are among the worst in the country. The South Coast Air Basin (SoCAB), which includes Los Angeles, Orange, Riverside and San Bernardino counties, is classified by the U. S. Environmental Protection Agency (EPA) as an extreme nonattainment area for ozone. The San Joaquin Valley Air Basin (SJVAB) also is designated an extreme nonattainment area for ozone. Both air basins are classified as serious nonattainment areas for $PM_{2.5}$. While promising reductions in some pollutants have been achieved, levels of ozone and fine particulate matter remain high.

Between 2005 and 2007 ambient ozone levels in the San Joaquin Valley exceeded the health-based 8-hour National Ambient Air Quality Standard (NAAQS) on from 112 to 139 days a year, while in the South Coast Air Basin exceedances occurred on from 115 to 120 days. Ozone levels are typically elevated in the warmer months, so this suggests that air is unhealthy on most summer days in these regions. Not only is the standard frequently exceeded, but between 2005 and 2007 the maximum 8-hour concentration was significantly above the standard. While ozone levels in much of California have fallen steadily over a period of years, progress in the San Joaquin Valley has been slower than in other major air basins.

To meet the maximum 24-hour standard, fine particulate levels must fall by more than 50%, and annual average concentrations must fall by nearly 30%. These health-based standards will be very difficult to achieve.

HEALTH FINDINGS: Some Residents More at Risk, but Nearly Everyone is Exposed

Almost every resident of the South Coast Air Basin and San Joaquin Valley Air Basin regularly experiences air pollution levels known to harm health and to increase the risk of early death. Specifically, from 2005 through 2007, each person was on average exposed to unhealthy levels of ozone on nearly 20 and more than 30 days a year in the South Coast and San Joaquin Valley, respectively. In Kern County, this rises to over 50 days each year, and in Riverside and San Bernardino Counties, nearly 50. In the San Joaquin Valley 66% of the population is exposed to health-endangering annual average levels of PM_{2.5}. In the South Coast, this averages over 64%, and in the most populated county – Los Angeles – it is 75%.

Because ozone exceedances typically occur during the warmer months (April through September), and the exceedances of the 24-hour PM_{2.5} standard typically occur in the fall and winter months, there is essentially no “clean” season in either air basin.

These exposures translate directly into poorer health and an elevated risk to every resident exposed, but the adverse impacts of air pollution are not distributed equally. Residents of Fresno, Kern, Kings and Tulare Counties experience significantly more days when the PM_{2.5} standard is exceeded than residents of other counties in the San Joaquin Valley, as do residents of San Bernardino and Riverside Counties, compared to the neighboring counties in the South Coast Air Basin. Tulare County also joins Fresno, Kern, Riverside and San Bernardino in being well above their basin averages for the number of days of exposure above the ozone standards. Children under the age of 5 are exposed to unhealthy ozone concentrations on more days than adults. Blacks and Hispanics experience somewhat more frequent exposures to elevated levels of PM_{2.5} than non-Hispanic whites do. These disadvantaged groups all stand to gain relatively more from successful pollution reduction efforts.

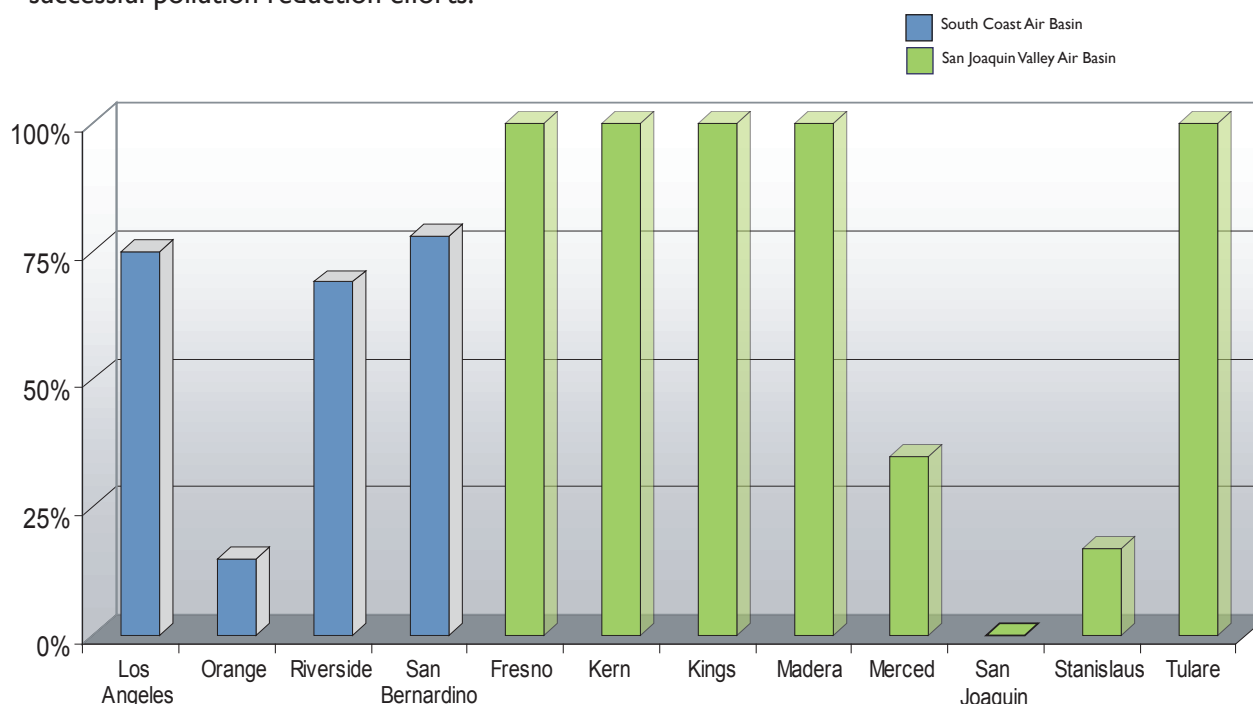


Figure E-1. Percent of the population exposed to PM_{2.5} concentrations above the average annual federal standard (15 µg/m³) in 2005-2007 by county.

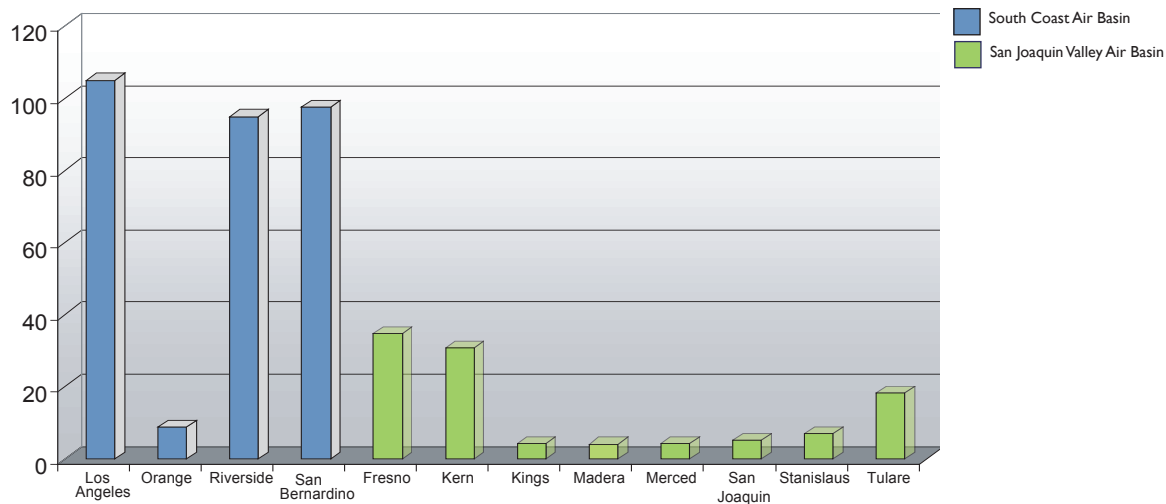


Figure E-2. Person-days per year (in millions) that residents are exposed to ozone concentrations above the 8-hr maximum federal standard (75 ppb) in 2005-2007 by county.

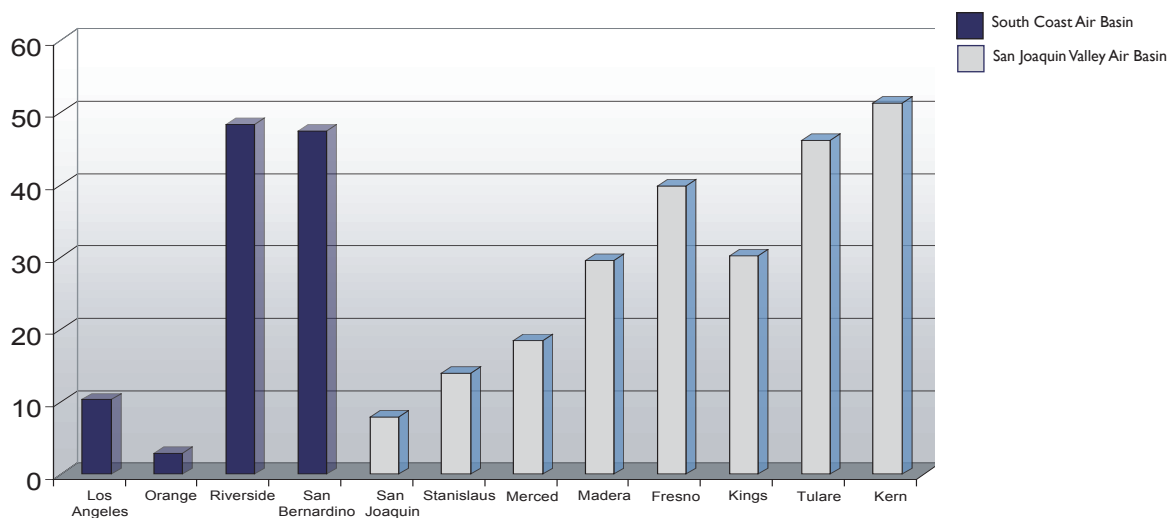


Figure E-3. Average days per year residents are exposed to ozone concentrations above the 8-hr maximum federal standard (75 ppb) in 2005-2007 by county.

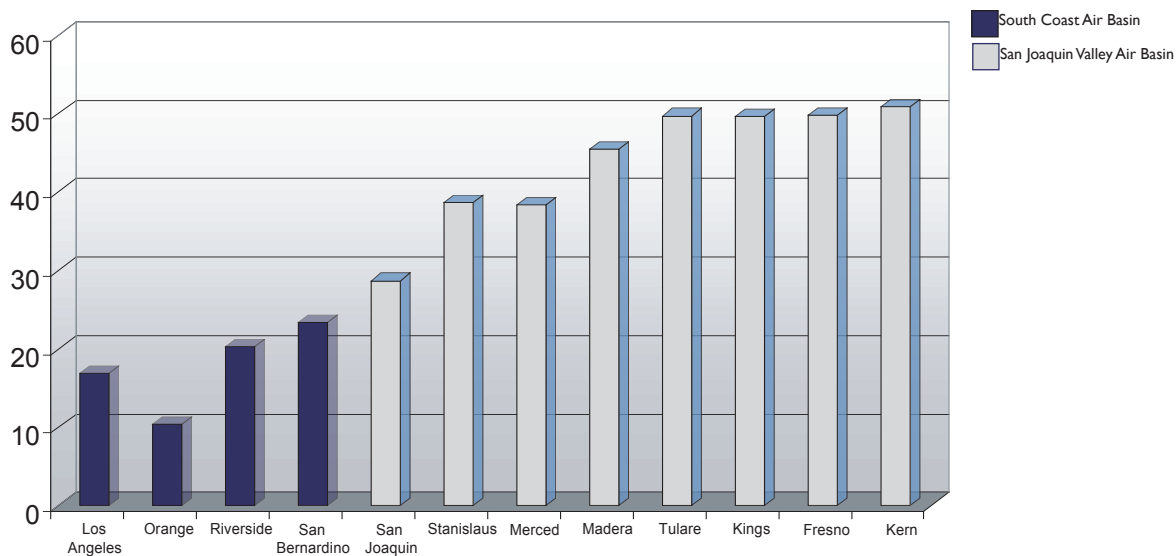


Figure E-4. Average days per year residents are exposed to PM_{2.5} concentrations above the 24-hr maximum federal standard (>35 µg/m³) in 2005-2007 by county.

ECONOMIC FINDINGS:

The Cost of the Status Quo and the Benefits of Meeting Federal Standards

In addition to the documented health effects caused by high levels of pollution, residents in these regions pay a high economic price for adverse air quality. Recognizing that some known effects of exposure to these pollutants, such as loss of lung function, cannot yet be quantified in economic terms, the actual economic benefits are likely higher than the results reported here.

Specifically,

- In the San Joaquin Valley overall, the cost of air pollution is more than \$1,600 per person per year, which translates into a total of nearly \$6 billion in savings if federal ozone and PM_{2.5} standards were met.
- In the South Coast Air Basin, the cost of air pollution is more than \$1,250 per person per year, which translates into a total of almost \$22 billion in savings if federal ozone and PM_{2.5} standards were met.

These dollar values represent avoiding the following adverse health effects of ozone and PM_{2.5} for the two air basins combined:

- 3,860 fewer premature deaths among those age 30 and older
- 13 fewer premature deaths in infants
- 1,950 fewer new cases of adult onset chronic bronchitis
- 3,517,720 fewer days of reduced activity in adults
- 2,760 fewer hospital admissions
- 141,370 fewer asthma attacks
- 1,259,840 fewer days of school absence
- 16,110 fewer cases of acute bronchitis in children
- 466,880 fewer lost days of work
- 2,078,300 fewer days of respiratory symptoms in children
- 2,800 fewer emergency room visits

To place the reduction in premature deaths in perspective, attaining the federal PM_{2.5} standard would save more lives than reducing the number of motor vehicle fatalities to zero in most of the counties in this study. In Los Angeles County, PM_{2.5}-related deaths are more than double the number of motor vehicle-related deaths.

IMPACT CHARTS

Ozone-Related Economic Benefits by County

| | RESPIRATORY HOSPITAL ADMISSIONS (ALL AGES) | ASTHMA ATTACKS ASTHMATIC POPULATION | EMERGENCY ROOM VISITS | DAYS OF SCHOOL ABSENCES | MINOR RESTRICTED ACTIVITY DAYS | MORTALITY | TOTAL |
|-------------------------------------|--|-------------------------------------|-----------------------|-------------------------|--------------------------------|--------------|---------------|
| San Joaquin Valley Air Basin | | | | | | | |
| Fresno | \$1,730,000 | \$301,000 | \$6,040 | \$3,350,000 | \$2,780,000 | \$19,880,000 | \$28,050,000 |
| Kern | \$1,550,000 | \$246,000 | \$4,620 | \$3,020,000 | \$2,240,000 | \$19,880,000 | \$26,940,000 |
| Kings | \$190,000 | \$47,000 | \$1,070 | \$480,000 | \$490,000 | \$0 | \$1,210,000 |
| Madera | \$230,000 | \$41,000 | \$710 | \$430,000 | \$410,000 | \$0 | \$1,110,000 |
| Merced | \$300,000 | \$58,000 | \$1,070 | \$680,000 | \$520,000 | \$0 | \$1,560,000 |
| San Joaquin | \$660,000 | \$121,000 | \$2,490 | \$1,210,000 | \$1,110,000 | \$0 | \$3,100,000 |
| Stanislaus | \$610,000 | \$111,000 | \$2,490 | \$1,200,000 | \$980,000 | \$6,630,000 | \$9,530,000 |
| Tulare | \$910,000 | \$156,000 | \$2,840 | \$1,650,000 | \$1,410,000 | \$13,250,000 | \$17,380,000 |
| South Coast Air Basin | | | | | | | |
| Los Angeles | \$15,400,000 | \$3,183,000 | \$54,120 | \$58,630,000 | \$31,790,000 | \$79,510,000 | \$188,600,000 |
| Orange | \$3,530,000 | \$916,000 | \$16,240 | \$22,300,000 | \$9,350,000 | \$19,880,000 | \$56,000,000 |
| Riverside | \$7,210,000 | \$1,210,000 | \$19,840 | \$12,170,000 | \$10,810,000 | \$99,390,000 | \$130,800,000 |
| San Bernardino | \$6,870,000 | \$1,205,000 | \$19,840 | \$12,880,000 | \$11,220,000 | \$72,890,000 | \$105,100,000 |

PM_{2.5}-Related Economic Benefits by County

| | PREMATURE & POST-NEO NATAL MORTALITY | RESPIRATORY SYMPTOMS & BRONCHITIS | NON-FATAL HEART ATTACKS | RESPIRATORY & CARDIO HOSPITAL ADMISSIONS | CHILDREN'S ASTHMA ER VISITS | MINOR RESTRICTED ACTIVITY DAYS | WORK LOSS DAYS | TOTAL |
|-------------------------------------|--------------------------------------|-----------------------------------|-------------------------|--|-----------------------------|--------------------------------|----------------|------------------|
| San Joaquin Valley Air Basin | | | | | | | | |
| Fresno | \$1,405,000,000 | \$41,220,000 | \$10,940,000 | \$3,030,000 | \$42,280 | \$6,710,000 | \$2,890,000 | \$1,470,000,000 |
| Kern | \$1,213,000,000 | \$33,710,000 | \$8,340,000 | \$800,000 | \$33,040 | \$5,190,000 | \$2,230,000 | \$1,263,000,000 |
| Kings | \$192,200,000 | \$7,261,000 | \$1,890,000 | \$390,000 | \$6,040 | \$1,210,000 | \$510,000 | \$203,500,000 |
| Madera | \$218,700,000 | \$6,439,000 | \$1,680,000 | \$490,000 | \$5,680 | \$1,040,000 | \$410,000 | \$228,800,000 |
| Merced | \$251,800,000 | \$8,349,000 | \$2,310,000 | \$530,000 | \$9,950 | \$1,410,000 | \$580,000 | \$265,000,000 |
| San Joaquin | \$728,900,000 | \$20,640,000 | \$5,470,000 | \$1,620,000 | \$19,180 | \$3,190,000 | \$1,400,000 | \$761,200,000 |
| Stanislaus | \$656,000,000 | \$18,940,000 | \$4,910,000 | \$1,460,000 | \$17,760 | \$2,950,000 | \$1,280,000 | \$685,600,000 |
| Tulare | \$728,900,000 | \$20,900,000 | \$5,400,000 | \$1,400,000 | \$22,380 | \$3,280,000 | \$1,250,000 | \$761,200,000 |
| South Coast Air Basin | | | | | | | | |
| Los Angeles | \$11,440,000,000 | \$421,200,000 | \$137,400,000 | \$35,790,000 | \$423,900 | \$80,460,000 | \$44,930,000 | \$12,160,000,000 |
| Orange | \$2,697,000,000 | \$104,700,000 | \$34,000,000 | \$6,950,000 | \$99,200 | \$19,710,000 | \$11,090,000 | \$2,874,000,000 |
| Riverside | \$3,055,000,000 | \$84,000,000 | \$25,940,000 | \$8,720,000 | \$92,000 | \$14,770,000 | \$7,160,000 | \$3,196,000,000 |
| San Bernardino | \$2,730,000,000 | \$89,460,000 | \$29,090,000 | \$7,450,000 | \$110,000 | \$17,530,000 | \$8,500,000 | \$2,882,000,000 |

IMPACT CHARTS

Ozone-Related Adverse Health Effects By County

| | RESPIRATORY HOSPITAL ADMISSIONS (ALL AGES) | ASTHMA ATTACKS ASTHMATIC POPULATION | EMERGENCY ROOM VISITS | DAYS OF SCHOOL ABSENCES | MINOR RESTRICTED ACTIVITY DAYS | MORTALITY |
|-------------------------------------|--|-------------------------------------|-----------------------|-------------------------|--------------------------------|-----------|
| San Joaquin Valley Air Basin | | | | | | |
| Fresno | 46 | 5,670 | 17 | 43,980 | 42,970 | 3 |
| Kern | 41 | 4,640 | 13 | 37,810 | 34,620 | 3 |
| Kings | 5 | 890 | 3 | 6,050 | 7,580 | 0 |
| Madera | 6 | 780 | 2 | 5,500 | 6,320 | 0 |
| Merced | 8 | 1,090 | 3 | 8,530 | 8,070 | 0 |
| San Joaquin | 17 | 2,290 | 7 | 13,100 | 17,170 | 0 |
| Stanislaus | 16 | 2,100 | 7 | 13,500 | 15,190 | 1 |
| Tulare | 24 | 2,940 | 8 | 23,040 | 21,830 | 2 |
| South Coast Air Basin | | | | | | |
| Los Angeles | 380 | 59,100 | 150 | 653,300 | 483,840 | 12 |
| Orange | 87 | 17,010 | 45 | 184,500 | 142,380 | 3 |
| Riverside | 185 | 22,480 | 55 | 125,840 | 164,470 | 15 |
| San Bernardino | 173 | 22,380 | 55 | 144,690 | 170,720 | 11 |

PM_{2.5}-Related Adverse Health Effects By County

| | PREMATURE & POST-NEO NATAL MORTALITY | RESPIRATORY SYMPTOMS & BRONCHITIS | NON-FATAL HEART ATTACKS | RESPIRATORY & CARDIO HOSPITAL ADMISSIONS | CHILDREN'S ASTHMA ER VISITS | MINOR RESTRICTED ACTIVITY DAYS | WORK LOSS DAYS |
|-------------------------------------|--------------------------------------|-----------------------------------|-------------------------|--|-----------------------------|--------------------------------|----------------|
| San Joaquin Valley Air Basin | | | | | | | |
| Fresno | 212 | 104,215 | 156 | 80 | 119 | 103,770 | 18,500 |
| Kern | 183 | 81,228 | 119 | 53 | 93 | 80,170 | 14,280 |
| Kings | 29 | 15,207 | 27 | 10 | 17 | 18,770 | 3,340 |
| Madera | 33 | 14,235 | 24 | 13 | 16 | 16,020 | 2,850 |
| Merced | 38 | 24,269 | 33 | 14 | 28 | 21,840 | 3,880 |
| San Joaquin | 110 | 46,908 | 78 | 43 | 54 | 49,360 | 8,740 |
| Stanislaus | 99 | 43,814 | 70 | 39 | 50 | 45,660 | 8,120 |
| Tulare | 110 | 54,678 | 77 | 37 | 63 | 50,750 | 9,030 |
| South Coast Air Basin | | | | | | | |
| Los Angeles | 1,727 | 1,000,440 | 1,960 | 903 | 1,175 | 1,224,600 | 241,690 |
| Orange | 411 | 233,310 | 485 | 175 | 275 | 300,010 | 59,100 |
| Riverside | 461 | 217,570 | 370 | 220 | 255 | 224,780 | 44,500 |
| San Bernardino | 412 | 260,480 | 415 | 187 | 305 | 266,830 | 52,850 |

IMPLICATIONS

More than 20,000,000 residents in these air basins face significant public health risks and high economic costs from the present unhealthful levels of ozone and fine particles. The findings in this study show how meeting federal clean air standards would bring substantial economic and health gains to the two regions. The benefits for the more populous or more polluted counties within each air basin would be even more pronounced.

As the state's population continues to increase, the gains from attaining the health-based air quality standards will grow, but also become more difficult to achieve. It is clear that identifying and acting on opportunities now to reduce emissions from the sources of ozone and fine particle pollution would produce substantial gains to more than 20 million Californians.

RESEARCH APPROACH

A well-established three-stage approach is used to determine the benefits of attaining the ozone and $PM_{2.5}$ air quality standards by identifying and quantifying the links between air quality and exposure, exposure and ill health, and avoiding ill health and the resulting economic gain.

Establishing the links between polluted air and exposure is accomplished using the Regional Human Exposure Model (REHEX), which was developed to estimate a population's exposure to concentrations above the air quality standards. This model accounts for the spatial and temporal pollution patterns across a region, which is important because pollution patterns vary significantly across a large area. Exposure for the populations in the SoCAB and SJVAB are estimated using 5x5 kilometer grids and 2005-2007 pollution levels. Averaging over three years reduces the influence of weather anomalies that do not accurately represent longer term trends in air quality. REHEX generates estimates of exposure by county, by age, and by ethnic group as defined by the U.S. Bureau of the Census.

These exposure estimates are then coupled with concentration-response functions from the health science literature to calculate how many fewer adverse health effects and premature deaths would be expected if the 2007 population instantaneously experienced attainment of the NAAQS.

Finally, economic values are applied to the avoided adverse health effects and extended lives to estimate in dollar terms the social value of more healthful air. These values are based on the cost of treating illness and the expressed value that people place on avoiding illness and premature death.