PARTICLE CIVICS

How Cleaner Air in California Will Save Lives & Save Money

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ENVIRONMENTAL WORKING GROUP™

Acknowledgments

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Executive Summary

Tougher state standards for particulate air pollution could save more than 6,500 lives and half a billion dollars a year.

Airborne soot and dust, technically known as particulate air pollution, causes or contributes to the deaths of more Californians than car accidents, murder and AIDS combined. State health officials are proposing new air pollution rules that could save or extend more than 6,500 lives a year, but the proposal faces strong and well-financed opposition from major oil companies and automakers.

In California, respiratory illnesses caused or made worse by airborne particulate matter (PM) are responsible for 9,300 deaths, 16,000 hospital visits, 600,000 asthma attacks and five million lost work days each year. By saving lives and preventing illnesses, tougher standards could save more than half a billion dollars a year.

In recent years, hundreds of studies worldwide have shown that PM pollution kills people. Both short- and long-term exposure to particulate pollution at levels lower than the levels currently experienced by millions of California residents can cause death. The proposed new PM standards are the first new regulations developed in response to a landmark 1999 state law requiring that air pollution standards must be adequate to protect children's health.

Statewide, total PM emissions are on the rise, and the great majority of Californians are exposed to potentially harmful levels. The worst particulate pollution in the state is found in Imperial County. But far more Californians are affected by the severe problems in the South Coast Air Basin, covering greater Los Angeles, which has the highest PM levels of any U.S. metro area, and the eight-county San Joaquin Valley, which is among the six worst areas in the nation. EWG estimates that the proposed new standards could save more than 4,200 lives a year in the South Coast Air Basin, and more than 800 lives a year in the San Joaquin Valley.

EWG urges the Air Resources Board to resist pressure from polluters and adopt the PM standards recommended by state scientists. Exemptions for agriculture should be eliminated. To further protect children and other sensitive populations, ARB should also set eight-hour PM standards, as it has for ozone. Finally, the state PM standards must be more rigorously enforced.

A Life and Death Decision

Particulate air pollution causes or contributes to the deaths of more Californians than car accidents, murder and AIDS combined, according to an analysis of state data by Environmental Working Group. EWG's investigation found that state health officials are proposing new air pollution rules that could save or extend more than 6,500 lives a year, but the safer standards face entrenched opposition from a deep-pockets alliance of major oil companies and automakers.

Airborne microscopic particles, much smaller than the width of a human hair, are known as particulate matter, or PM. (The smallest particles are often called "fine" particulates; the larger ones, still very tiny, are called "coarse" particulates.) California Department of Health Services (DHS) data shows that respiratory illnesses caused or made worse by PM pollution are responsible for the deaths of more than 9,300 Californians a year. That is three times more than are killed in car accidents, 4.6 times more than those who are victims of homicide and six times the number who die of AIDS. (Table 1.) What's more, even this number is an underestimate of the total number of PM-related deaths each year since it includes all deaths due to long-term exposure but only includes some of those due to short-term exposure to particulate air pollution[1].

The air polluters' lobby tries to divert attention from the overwhelming evidence that particulate matter is deadly by arguing that compliance with the "impossibly stringent" proposed new standards would be too costly and would not produce

Cause of Death	Number of Deaths in 1999
Particulate air pollution	9,340
Motor vehicle accidents	3,140
Suicide	3,047
Accidental poisonings	2,221
Homicide	2,042
HIV/AIDS	1,558
Accidental falls	1,202
Drownings	397

Source: EWG, from California Department of Health Services 1999.

Table 1. Particulate air pollution in California causes or contributes to more than 9,000 deaths each year.

"any greater protection of public health than the current California standards." (Ford 2002, AAM 2002.) But EWG's five-month review of hundreds of state, national and international studies found just the opposite: By saving lives and preventing illnesses, tougher PM standards could save the state and its citizens more than half a billion dollars a year.

The price tag: $1 billion a year

Each year, PM pollution is responsible for more than 16,000 hospital or emergency room admissions, at an estimated health care cost of $132 million. PM-triggered illnesses also cause Californians to miss almost five million work days a year, a loss to the state's economy of more than $880 million[2]. More difficult to put a price tag on are the thousands of less severe illnesses that result every year from PM pollution, including 600,000 asthma attacks and 13,500 cases of chronic bronchitis in California. (Tables 2, 3.)

Particulates, which are taken deep into the lungs by inhalation, have been linked with a long list of respiratory ailments such as chronic cough, chest pain, breathlessness, wheezing, phlegm, chronic bronchitis, decreased lung growth, decreased lung function, and the exacerbation of asthma symptoms.

Table 2. Proposed new standards would prevent hundreds of thousands of illnesses each year.

	Ages Considered	Cases at Current PM Levels	Cases Under Proposed Standards	Cases Avoided	Cases Reduced by
Long-term Mortality	30+	9390	2865	6525	69%
Short-term Mortality	All	4063	1772	2291	56%
Chronic Bronchitis	27+	13530	5696	7835	58%
Chronic Obstructive Pulmonary Disease Hospital Admissions	65+	2115	923	1192	56%
Pneumonia Hospital Admissions	65+	3061	1340	1721	56%
Cardiovascular Disease Hospital Admissions	65+	5452	2395	3057	56%
Asthma Hospital Admissions	64-	1624	692	933	57%
Asthma Emergency Room Visits	64-	3992	1691	2301	58%
Asthma Attacks	All	592736	254466	338270	57%

Notes: In this table, the long-term mortality values are for PM2.5 and the short-term mortality values are for PM10. Long-term mortality is deaths from long-term exposure to particulates, while short-term is deaths from short-term exposure. Because the estimates of long-term mortality include some but not all short-term deaths, the two cannot be added together to get an estimate of total mortality.

Source: EWG, from ARB/OEHHA 2001, EWG 2002.

PM concentrations have also been shown to be associated with hospital admissions for a wide variety of cardiovascular and pulmonary diseases, including asthma. Groups particularly at risk include children, the elderly, people who already suffer from respiratory illness, and those of low socioeconomic status, who tend to live in areas where particulate pollution is most severe.

In recent years, a major international scientific effort has produced a flood of studies that has clearly established that PM pollution can kill people. Epidemiological studies have been conducted in over 200 cities worldwide, examining the effects of different exposure durations, and accounting for contributing factors including age, smoking habits, weather, and other pollutants. The results have been remarkably consistent: Both short- and long-term exposure to particulate pollution at levels lower than currently experienced by millions of California residents can cause death. Compared to just a few years ago, scientists today are much more likely to say plainly that PM kills, than that it contributes to death.

Hundreds of studies worldwide confirm that exposure to particulate pollution at levels lower than millions of Californians breathe can cause death.

California's current PM standards were set in 1982. New standards proposed by scientists at the state Air Resources Board (ARB) and Office of Environmental Health Hazard Assessment (OEHHA) would reduce the number of PM-triggered deaths and illnesses dramatically. The scientists say cutting allowable levels of PM to recommended levels will reduce deaths by at least 69 percent, asthma attacks by 57 percent, hospital visits by 56 percent and cases of chronic bronchitis by 58 percent. (Table 2.) Statewide, the recommended standards would result in an annual reduction of about 3 percent of all mortality in the population above age 30. (ARB/OEHHA 2001.) EWG estimates that these new PM-standards would also result in savings of state direct and indirect costs of more than $580 million a year. (Table 3.)

The Children's Environmental Health Act

Gov. Gray Davis' appointed ARB directors are scheduled to vote on the proposed new standards in June 2002. Their decision is being watched closely by health and environmental officials and researchers across the country. In 1999, California enacted the landmark Children's Environmental Health Act (SB 25), the first law anywhere in the U.S. to require that air pollution standards must be stringent enough to protect children – as opposed to almost all other environmental regulations designed to protect the average adult male. SB 25 required the ARB to review all of the state's air pollution standards to determine whether they adequately protect children. A preliminary review determined that the current PM standards were inadequate and that revising them should be ARB's highest priority. Other standards determined to be inadequate must be revised at a rate of one a year[3]. The proposed PM standards could again make California the national leader in air quality standards to protect public health – but not if the air polluters' lobby gets its way.

The Western States Petroleum Association, the Alliance of Auto Manufacturers, the Engine Manufacturers Association and other industry groups and individual companies have mounted a well-financed major campaign against the proposed

Table 3. Costs Associated With PM10-related Illness in California.

	Ages Considered	Number at Current PM10 Level	Cost at Current PM10 Level (1999 $)	Number Avoided Under Proposed New Standards	Savings Under Proposed New Standards
Chronic Obstructive Pulmonary Disease Hospital Admissions [1]	65+	2,115	$24,792,990	1,192	$13,972,624
Pneumonia Hospital Admissions [2]	65+	3,061	$42,639,263	1,721	$23,971,809
Cardiovascular Disease Hospital Admissions [3]	65+	5,452	$34,362,621	3,057	$19,268,271
Asthma Hospital Admissions [4]	64-	1,624	$28,904,937	933	$16,601,802
Asthma Emergency Room Visits [5]	64-	3,992	$1,193,527	2,301	$687,999
Work Loss Days [6]	64-	4,910,652	$883,917,360	2,814,815	$506,666,700
Total		4,926,896	$1,015,810,698	2,824,019	$581,169,205

Notes:
1) Hospital charge cost only. Mean hospital stay is 6.02 days with a mean charge of $11,722 (1999 dollars). (Abt 2000)
2) Hospital charge cost only. Mean hospital stay is 7.01 days with a mean charge of $13,929 (1999 dollars). (Abt 2000)
3) Hospital charge cost only. Mean hospital stay is 5.44 days with a mean charge of $17,794 (1999 dollars). (Abt 2000)
4) Hospital charge cost only. Mean hospital stay is 3.03 days with a mean charge of $6,303 (1999 dollars). (Abt 2000)
5) The average asthma ER visit cost is $299 (1999 dollars). (Abt 2000)
6) The median per-day income of California residents in the year 2000 was $180. (US Census 2002)

Source: ARB/OEHHA 2001, EWG 2002, Abt 2000, U.S. Census 2000.

standards. Their tactics are familiar: carping on minor inconsistencies between scientific studies, exaggerating uncertainties although PM is perhaps the most-studied type of air pollutant, and drawing on industry-funded studies to dispute the overwhelming consensus of peer-reviewed academic and government research. If their campaign, for which a small army of lobbyists in Sacramento has millions of dollars to spend, is only partly successful in watering down the proposed standards, thousands more Californians will die from dirty air each year.

Unlike most other air pollutants, particulates are regulated by size. Particles with diameters less than or equal to 10 microns are called PM10 and are often referred to as “coarse particles.” Particulates with diameters less than or equal

to 2.5 microns are called PM2.5 and are often referred to as "fine particles." (A single human hair has a diameter of 50 to 100 microns.) California's current standards regulate only PM10, but the proposed new standards would also cover PM2.5.

PM contains heavy metals, nitrates, sulfates, aerosols and other toxic chemicals, as well as ordinary soot, soil, dust and smoke from both man-made and natural sources, including cars, industrial pollution and unpaved roads. Recent research suggests that PM from industrial and other man-made sources is more harmful to human health than dust from natural sources. (See Chapter 3.) The makeup of PM pollution varies considerably among different locations and at different times of the year (or even day) in the same location. As a result, two areas in California with the same level of particulates in the air may have distinctly different PM problems, and within counties where overall PM levels are relatively low, individual cities or neighborhoods may be exposed to high levels. Although annual average PM levels have declined in recent years, only small, mostly rural Lake County is in full compliance with current state standards. Statewide, total PM emissions are on the rise, and the great majority of Californians are exposed to potentially harmful levels:

The Los Angeles–Riverside metro area has the worst particulate air pollution in the U.S., and the San Joaquin Valley's problem is also among the worst.

- Over 99 percent of Californians breathe air that violates the current PM10 standards during at least part of the year. (ARB/ OEHHA 2000.)

- Fifty-five of fifty-eight counties have average annual PM10 concentrations that exceed the proposed standards and fourteen counties (or portions of counties) have average annual concentrations that are at least twice as high, based on the last three years of ARB monitoring data[4]. (Table 4.)

- Forty-three counties (or portions of counties) have average annual PM2.5 concentrations that exceed the proposed standards, based on the last two years of ARB monitoring data[5]. (Table 4.)

Preventing deaths and asthma

The worst particulate pollution in the state is found in Imperial County (and an adjoining part of Riverside County). But far more Californians are affected by the severe problems in the South Coast Air Basin (Los Angeles, Orange, Riverside and San Bernardino counties) which consistently records the highest PM levels of any U.S. metro area, and the eight-county San Joaquin Valley, which ranks among the six worst air basins in the country for particulate pollution. (Grossi 2002, Table 4.) Considering the same factors state scientists used in calculating statewide PM-related deaths and illnesses, EWG estimates that the proposed new standards could prevent or delay more than 4,200 deaths a year in the South Coast Air Basin, and more than 800 deaths a year in

Table 4.
55 of California's 58 counties are not in full compliance with existing PM standards.

Source: EWG, from ARB/ OEHHA 2001.

County	Portion of County*	PM10 Annual Average (ug/m^3)**	PM2.5 Annual Average (ug/m^3)***
Alameda		21.7	15.8
Alpine		16.7	8.5
Amador		23.0	16.6
Butte		24.5	12.3
Calveras		23.0	16.6
Colusa		24.5	12.3
Contra Costa		21.7	15.8
Del Norte		17.5	7.5
El Dorado	Lake Tahoe Basin	20.8	7.5
El Dorado	Mountain Counties Basin	23.0	16.6
Fresno		39.5	22.3
Glenn		24.5	12.3
Humbolt		17.5	7.5
Imperial		70.2	13.1
Inyo		16.7	8.5
Kern	Mojave Basin	21.6	10
Kern	San Joaquin Basin	39.5	22.3
Kings		39.5	22.3
Lake		10.8	≤ 5
Lassen		13.0	≤ 5
Los Angeles	Mojave Basin	21.6	10
Los Angeles	South Coast Basin	40.7	22.2
Madera		39.5	22.3
Marin		21.7	15.8
Mariposa		23.0	16.6
Mendocino		17.5	7.5
Merced		39.5	22.3
Modoc		13.0	≤ 5
Mono		16.7	8.5
Monterey		24.2	7.5
Napa		21.7	15.8
Nevada		23.0	16.6
Orange		40.7	22.2
Placer	Lake Tahoe Basin	20.8	7.5
Placer	Sac Valley Basin	24.5	12.3
Plumas		23.0	16.6
Riverside	Mojave Basin	21.6	10
Riverside	Salton Sea Basin	70.2	13.1
Riverside	South Coast Basin	40.7	22.2
Sacramento		24.5	12.3
San Benito		24.2	7.5
San Bernardino	Mojave Basin	21.6	10
San Bernardino	South Coast Basin	40.7	22.2
San Diego		28.8	15.6
San Francisco		21.7	15.8
San Joaquin		39.5	22.3
San Luis Obispo		23.0	11.8
San Mateo		21.7	15.8
Santa Barbara		23.0	11.8
Santa Clara		21.7	15.8
Santa Cruz		24.2	7.5
Shasta		24.5	12.3
Sierra		23.0	16.6
Siskiyou		13.0	≤ 5
Solano	Sac Valley Basin	24.5	12.3
Solano	San Francisco Basin	21.7	15.8
Sonoma	North Coast Basin	17.5	7.5
Sonoma	San Francisco Basin	21.7	15.8
Stanislaus		39.5	22.3
Sutter		24.5	12.3
Tehama		24.5	12.3
Trinity		17.5	7.5
Tulare		39.5	22.3
Tuolumne		23.0	16.6
Ventura		23.0	11.8
Yolo		24.5	12.3
Yuba		24.5	12.3

the San Joaquin Valley. Each year, more than 76,000 asthma attacks could be averted in Riverside and San Bernardino counties alone. (Table 5.)

In December 2001, ARB and OEHHA staff scientists proposed that California's annual PM10 standard be lowered by one-third, from 30 micrograms per cubic meter of air ($\mu g/m^3$) to 20 micrograms, and that an annual state PM2.5 standard be set at 12 $\mu g/m^3$. But the agencies also had to decide about standards for short-term (24-hour) exposures to PM. They proposed to leave the short-term standard for PM10 unchanged at 50 $\mu g/m^3$. They at first opted not to propose a state short-term standard for PM2.5, continuing to rely on the federal level of 65 $\mu g/m^3$. After criticism from an external scientific review panel and pressure from state environmental advocates, however, ARB and OEHHA decided a state short-term PM2.5 standard was necessary, and in March 2002 proposed a level of 25 $\mu g/m^3$. (Figures 1 and 2.)

When the ARB directors meet to set the final standards, the stakes are high. If the annual PM10 standard is strengthened only slightly to 28 $\mu g/m^3$, and the PM2.5 standard is set at the federal level of 15 $\mu g/m^3$, as the oil companies and automakers advocate, the result would be 3,000 more premature deaths, 3,000 more hospital admissions, 1,000 more emergency room visits for asthma, 3,500 more cases of chronic bronchitis, and 150,000 more asthma attacks each year than if the standards were set at the proposed levels. For thousands of Californians, it will be literally a life-and-death decision.

Gov. Davis' air quality board should adopt the tougher regulations recommended by state scientists, and enforce them rigorously.

Recommendations

- Directors of the Air Resources Board should resist pressure from polluters and adopt both the annual and short-term PM10 and PM2.5 standards recommended by state scientists.

- The *de facto* state exemption from PM regulations for most agricultural activities – a major source of particulate pollution in California – should be eliminated.

- To further protect children and other sensitive populations from acute levels of particulates, ARB should also set shorter-term standards for PM10 and PM2.5, on the model of the state's eight-hour standard for ozone air pollution.

- The PM standards adopted by the state should be rigorously enforced. Currently the standards are non-binding, making enforcement inconsistent and ineffective.

Footnotes

[1] This figure is for estimated mortality due to long-term exposures to PM2.5 air pollution. It is difficult to arrive at an absolute number of PM-related deaths because of overlap in various estimates. For instance, the figures for long-term mortality are believed to encompass some but not all short-term deaths, and therefore estimates of short and long-term mortality can not be simply added together to get an estimate of total mortality.

[2] The median per-day income of California residents in the year 2000 was $180 (=46,802 dollars per year / 260 work days per year). (U.S. Census Bureau 2000.) The actual number of work days lost to PM10-related illness is 4,910,652. (OEHHA/ARB 2001.) The estimated cost to the state's economy is the product of these two numbers.

[3] OEHHA categorized the air pollutants under review into two tiers based on the agency's assessments of potential risks to public health. The first tier includes PM, ozone and nitrogen dioxide. The second tier includes lead, carbon monoxide, and hydrogen sulfide.' (OEHHA/ARB 2001.)

[4] Average PM10 levels were calculated by ARB using the last three years of data available (1998-2000). (OEHHA/ARB 2001.)

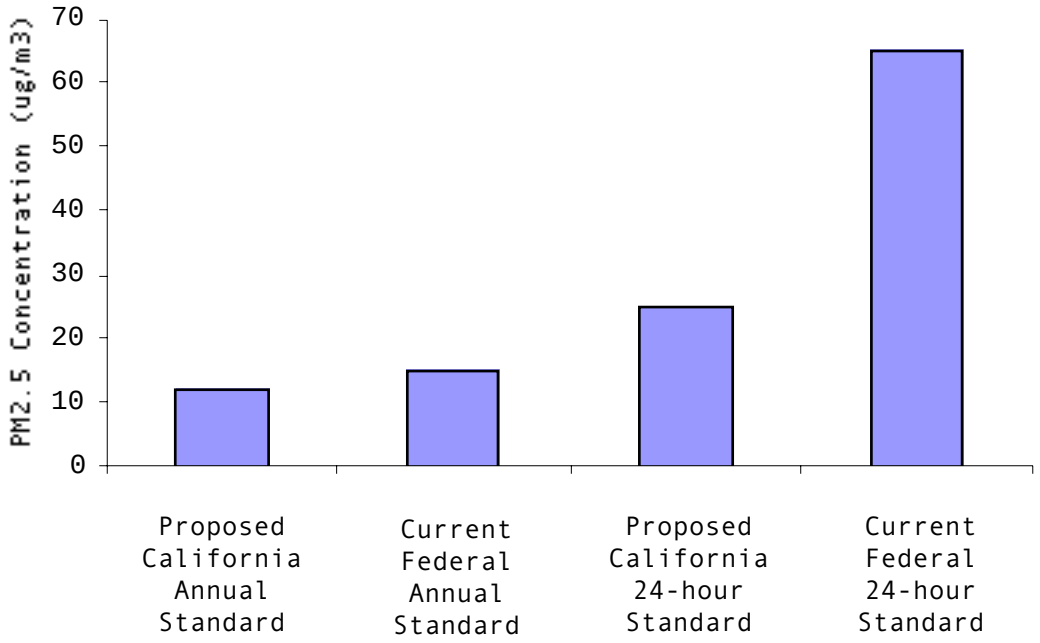
[5] Average PM2.5 levels were calculated by ARB using the last two years of data (1999-2000), which is all the monitoring data available. (OEHHA/ARB 2001.)

California's Particulate Problem

Emissions of particulates have been increasing in California for decades, from 2,017 tons of PM10 per day in 1980, to 2,240 tons per day in 1990, to 2,312 tons per day in 2000. (ARB 2001.) However, the increase has been far from uniform across the state. During this period, PM10 emissions in some counties have remained relatively steady or declined, while other counties have seen a marked increase. For instance, between 1975 and 2000, emissions in San Bernardino County increased by 93 percent and in San Diego County by 70 percent. (ARB 2001.) The increase in emissions comes from many sources, but one clear cause is the ever-growing dependence on automobiles: From 1975 to 2000 the number of vehicle miles traveled in California more than doubled, from 351 million miles per day to 800 million. (ARB 2001.)

While the total *amount* of emissions continues to rise, concentrations of PM10 *measured* by air quality monitors have actually declined. Statewide, annual mean concentrations measured by the state's 250 air monitors dropped 20

Figure 1. Proposed and Existing PM2.5 Standards



percent between 1988 and 1999, from about 80 μg/m^3 to 60. A big reason for this apparent discrepancy is that most of the monitors are in the South Coast Air Basin, where in recent years progress has been made in reducing PM emissions. Since the current PM standards were adopted in 1982, improvements in air quality have been achieved statewide, but today all counties except Lake County still fail to meet the state's short-term PM10 standard. (Lassen, Modoc and Siskyou counties lack enough data to measure compliance.) Twenty counties fail to meet even the considerably weaker federal short-term PM10 standard.' (Table 4.)

Problem areas

In most areas of the state with elevated PM levels, the problem is not limited to short-term spikes in concentration but is a year-round concern. By far the highest levels are found in Imperial County and an adjacent portion of Riverside County, with an annual average of 70 μg/m^3 of PM10 – almost 3.5 times the proposed state standard. But annual levels of 40 μg/m^3 or more of PM10 – twice the proposed standard— are recorded in twelve other counties or portions of counties: Fresno, Kern, Kings, Los Angeles, Madera, Merced, Orange, Riverside, San Bernardino, Stanislaus, San Joaquin and Tulare. (Table 4.)

PM differs from many other types of air pollution in that it is not a single compound, but rather a highly complex mixture of small solid particles and

Figure 2. Proposed and Existing PM10 Standards.

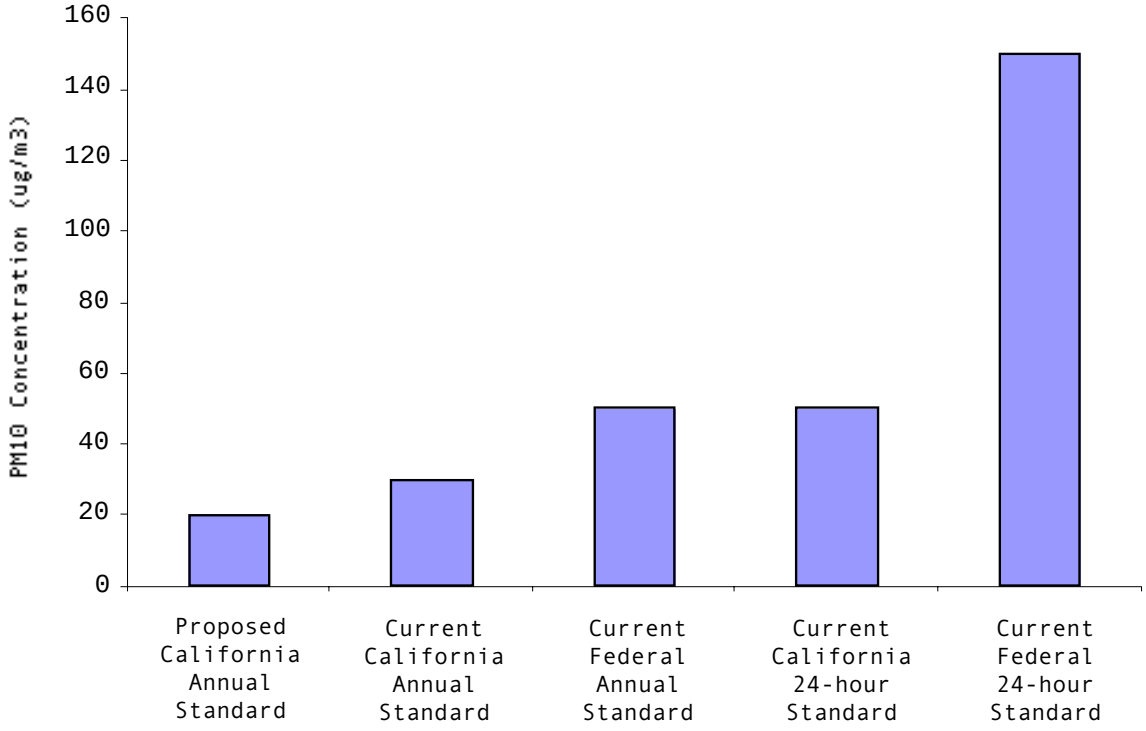


Table 5. Consequences of PM exposure, by county.

	Long-term mortality		Short-term mortality		Asthma Hospital Admissions		Asthma Emergency Room Visits		Asthma Attacks		Work Loss Days	
County	Deaths Due to PM2.5 at Current Levels	Fewer Deaths if Proposed Standards Achieved	Deaths Due to PM10 at Current Levels	Fewer Deaths if Proposed Standards Achieved	Admissions due to PM10 at Current Levels	Fewer Admissions if Proposed Standards Achieved	Visits Due to PM10 at Current Levels	Fewer Visits if Proposed Standards Achieved	Attacks Due to PM10 at Current Levels	Fewer Attacks if Proposed Standards Achieved	Days lost due to PM10 at current levels	Fewer Days Lost if Proposed Standards Achieved
Alameda	317	178	92	13	36	5	89	13	12,944	1,861	142,140	15,940
Alpine	0	0	0	0	0	0	0	0	6	0	93	0
Amador	12	7	4	1	1	0	2	1	349	80	3,334	626
Butte	32	3	24	8	6	2	14	5	2,257	704	21,072	5,629
Calveras	14	9	5	1	1	0	3	1	404	93	3,845	723
Colusa	2	0	1	0	1	0	1	0	209	65	2,053	548
Contra Costa	197	111	63	9	23	3	58	8	8,507	1,223	92,286	10,349
Del Norte	0	0	2	0	0	0	1	0	160	0	2,156	0
El Dorado	85	52	13	2	4	1	10	2	1,503	304	15,576	2,534
Fresno	311	243	126	83	49	33	121	81	17,894	11,905	138,277	99,442
Glenn	4	0	2	1	1	0	2	1	294	92	2,835	757
Humbolt	0	0	7	0	2	0	5	0	735	0	9,922	0
Imperial	15	4	38	32	17	15	41	35	6,370	5,348	40,840	42,511
Inyo	0	0	1	0	0	0	1	0	93	0	1,242	0
Kern	223	172	98	61	37	23	90	57	13,296	8,317	106,695	69,919
Kings	40	31	16	11	8	5	20	14	2,898	1,928	23,021	16,556
Lake	0	0	0	0	0	0	0	0	38	0	2,639	0
Lassen	0	0	0	0	0	0	1	0	78	0	2,061	0
Los Angeles	3555	2,759	1,387	930	599	405	1,469	997	217,366	146,105	1,672,103	1,220,537
Madera	50	39	21	14	7	5	18	12	2,756	1,833	21,026	15,121
Marin	55	31	16	2	6	1	15	2	2,217	319	23,452	2,630
Mariposa	6	4	2	0	0	0	1	0	170	39	1,644	309
Mendocino	0	0	5	0	1	0	3	0	501	0	6,680	0
Merced	79	62	32	21	13	9	32	22	4,713	3,136	36,585	26,310
Modoc		0	0	0	0	0	0	0	22	0	521	0
Mono	0	0	0	0	0	0	0	0	67	0	1,016	0
Monterey	0	0	27	8	12	4	30	9	4,391	1,318	44,102	11,262
Napa	37	21	11	2	3	0	7	1	1,114	160	11,536	1,294
Nevada	30	18	9	2	2	1	6	1	916	211	8,804	1,655
Orange	956	744	410	277	182	124	447	306	66,218	44,928	506,007	374,751
Placer	25	2	21	6	7	2	19	6	2,733	832	26,429	6,869
Plumas	7	4	2	0	1	0	1	0	207	48	1,981	372
Riverside	583	431	353	256	112	82	272	200	42,149	30,675	296,622	243,660
Sacramento	132	12	106	33	37	12	92	29	13,594	4,238	133,938	35,779
San Benito	0	0	3	1	2	0	4	1	582	175	5,969	1,524
San Bernardino	486	370	231	144	95	60	234	147	34,127	21,263	276,676	180,041
San Diego	560	308	279	131	110	52	273	130	40,465	19,074	358,663	159,824
San Francisco	203	114	60	9	19	3	46	7	6,964	1,001	73,543	8,247
San Joaquin	251	196	101	67	34	23	84	57	12,616	8,393	96,729	69,562
San Luis Obispo	26	0	21	5	7	2	16	4	2,471	581	24,534	4,727
San Mateo	150	84	45	6	17	2	42	6	6,340	912	67,890	7,613
Santa Barbara	37	0	29	7	11	3	27	6	4,000	940	40,532	7,809
Santa Clara	271	152	82	12	42	6	104	15	15,085	2,169	166,914	18,718
Santa Cruz	0	0	20	6	8	2	19	6	2,793	838	28,076	7,170
Shasta	25	2	19	6	5	1	12	4	1,814	566	17,043	4,553
Sierra	1	1	1	0	0	0	0	0	35	8	339	64
Siskiyou		0	0	0	0	0	1	0	102	0	2,428	0
Solano	60	29	23	5	11	2	26	5	3,790	773	40,655	6,672
Sonoma	99	56	35	4	11	1	26	4	3,938	520	42,970	4,336
Stanislaus	193	150	79	52	27	18	67	45	10,006	6,657	76,857	55,272
Sutter	9	1	7	2	2	1	6	2	877	273	8,519	2,276
Tehama	9	1	7	2	2	1	4	1	623	194	5,802	1,550
Trinity	0	0	0	0	0	0	0	0	76	0	966	0
Tulare	145	113	58	38	23	15	56	37	8,238	5,481	63,764	45,855
Tuolumne	18	11	5	1	1	0	3	1	542	125	5,148	968
Ventura	57	0	47	11	21	5	52	12	7,544	1,773	78,649	15,153
Yolo	15	1	13	4	5	2	13	4	1,874	584	18,826	5,029
Yuba	8	1	6	2	2	1	5	1	669	209	6626	1,770
Total	9,390	6,525	4,063	2,291	1,624	933	3,992	2,301	592,736	338,270	4,910,652	2,814,815

Source: EWG, from ARB/OEHHA 2001.

liquid droplets suspended in air. These particles may be emitted directly into the air or they may form in the atmosphere from "precursor" chemicals such as sulfur and nitrogen compounds. Substances that comprise PM range from soot, soil, organics, dust, and smoke to heavy metals, aerosols, nitrates, and sulfates. The makeup of PM pollution varies considerably among different locations and at different times of the year (or even day) in the same location. The diverse composition and distribution of particulate pollution makes it especially difficult to assess and control.

Particulate pollution comes from both natural and human sources. The five leading sources of PM10 emissions in California are in the catchall category of "dust" – unpaved road dust, paved road dust, and windblown dust together comprise about 55 percent of the total, with construction and agriculture each contributing another 9 percent. (Table 6.) Other significant human sources of PM10 emissions are industrial pollution and fuel combustion (6 percent combined), fireplaces and wood stoves (6 percent), burning waste (6 percent) and vehicle exhaust (5 percent). (ARB 2000a.)

Unlike most air pollutants, which are regulated based on their chemical composition, particles are regulated based on their size: those with diameters greater than 10 microns, those with diameters less than or equal to 10 microns (PM10), and those with diameters equal to or less than 2.5 microns (PM2.5). (One micron is one millionth of a meter, and a single human hair has a diameter of 50 to 100 microns.) The human respiratory system can filter out most particles larger than 10 microns. But as the particles get smaller they are

Table 6.
Sources of PM10 pollution in California.

PM10 Source	Tons of PM10 Emitted per Year	Percent of Total
Unpaved road dust	235,060	27%
Paved road dust	140,890	16%
Windblown dust	106,945	12%
Construction	74,825	9%
Farming	79,935	9%
Woodstoves & fireplaces	51,465	6%
Waste burning	50,735	6%
Mobile vehicles*	45,625	5%
Wildfires	31,755	4%
Industrial	32,485	4%
Fuel combustion	15,695	2%
Other	11,315	1%
Total	876,730	100%

* includes cars, trucks, airplanes, trains, and boats

Source: EWG, from ARB 2000.

Table 7. Comparison of PM2.5 (Fine Particles) and PM10 (Coarse Particles).

	FINE	COARSE
Formed from	Gases	Large solids/droplets
Formed by	Chemical reaction Nucleation Condensation Coagulation Evaporation	Mechanical disruption (crushing, grinding, etc.) Evaporation of sprays Suspension of dusts
Composed of	Sulfate Nitrate Ammonium Hydrogen ion Elemental carbon Organic compounds Metals Particle-bound water	Resuspended dusts Soil, dust, street dust Oxides of crustal elements Sea salt, calcium carbonate Pollen, mold, fungal spores Plant/animal fragments Tire wear debris
Solubility	Largely soluble	Largely insoluble
Sources	Combusiton of coal, oil, gasoline, diesel, wood Atmospheric transformation products of nitrogen oxides, sulfur dioxide, and organics High temperature processes, smelters, steel mills, etc.	Resuspension of industrial dust and soil tracked onto roads and streets Suspension from disturbed soil, e.g. farming, mining Biological sources Construction Coal and oil combustion Ocean spray
Lifetime	Days to weeks	Minutes to hours
Travel distance	100s to 1000s of kilometers	<1 to 10s of kilometers

Source: EWG, from US EPA 1996.

able to penetrate deeper into the lungs, and are harder for the body to remove. Therefore, over the past two decades, researchers and regulators have focused on ever-smaller inhalable particles. The U.S. Environmental Protection Agency first set standards for PM10 in 1987 and set standards for PM2.5 in 1997.

PM10 and PM2.5 also differ in their sources, how they are formed, composition, and lifetime in the atmosphere. Fine particulates are generated from fossil fuel combustion and other high-temperature processes, are formed from gases which then react and coagulate in the atmosphere and persist in the air for days or weeks. Coarse particulates are usually generated from the suspension of dust from natural or man-made sources, are composed of very small particles or droplets rather than gases, and remain in the air for minutes to hours. (Table 7.) (U.S. EPA 1996.)

Dust in the wind

More than 70 percent of PM10 emissions in the state are from "dust," which includes wind-blown dust from paved and unpaved roads, farming and ranching, and construction sites. Agriculture is a major source of PM10, but its impact is somewhat hidden because ag-related emissions fall into a number of different categories: farming operations, windblown dust, waste burning, industrial processes and farm vehicles. All told, California agriculture produces 459 tons of PM10 a day, or more than 167,500 tons a year. The farm-related particulates problem is so severe in the San Joaquin Valley that the region has repeatedly been unable to meet federal PM standards, and stands to lose more than $2 billion in federal highway funds if the eight counties can't achieve a five percent annual reduction in particulate levels – the only air basin in the country to be hit with such sanctions.

Yet the agricultural industry is exempt from most air pollution laws. The federal Clean Air Act exempts emissions from farm equipment of less than 175

Table 8. Leading Industrial Sources of PM10 Pollution in California.

Facility Name	City	Tons of PM10 Emitted per Year
ADM Inc (Wood Products)	Benicia	1,376
US Borax	Boron	614
Kern Oil & Refining	Bakersfield	544
IMC Chemicals	Trona	526
Mitsubishi Cement	Lucerne Valley	472
Chevron	El Segundo	472
Arco	Carson	452
Ampine (Wood Products)	Martell	447
Port of Stockton	Stockton	436
Martinez Refining Company	Martinez	433

Source: EWG, from ARB 2001.

horsepower. Strictly speaking, California doesn't exempt farm sources from air pollution *regulations*, but does exempt farm operations from having to obtain an air pollution *permit* – and without the conditions attached to a permit, there is no effective control on emissions. The EPA has announced that it will commission the National Academy of Sciences to study agricultural sources of air pollution, which could lead to full-scale regulation of air pollution from farming operations.

Dirty diesels

"Mobile" sources (vehicles) contribute about 5 percent of California's annual PM10 emissions. Passenger cars and light trucks are responsible for about a quarter of this pollution, with most of the rest coming from heavy duty trucks, farm and construction and both commercial and recreational boats. But the bad actor of the category is diesel fuel. Even though diesel-fueled vehicles make up only 4 percent of the 31 million vehicles on the road in California, diesels are responsible for 53 percent of all auto-related PM emissions in California. (ARB 2000b.) And in addition to the adverse health effects associated with all other sources of particulate matter, diesel PM contains many known carcinogens. ARB estimates that diesel-derived PM is responsible for 900 excess cases of cancer per 1 million people exposed over a 70-year lifetime, accounting for 70 percent of the known statewide cancer risk from outdoor air toxics. (ARB 2000b.)

Agriculture is the largest industry in California and a major source of particulates, but is exempt from most air pollution rules.

Industrial emissions account for about 4 percent of California's PM10 pollution. The list of the leading industrial polluters includes petrochemical companies like Chevron, Arco and other refiners, but by far the worst offender is ADM Inc., a manufacturer of wood products in Benicia, Solano County, with more than 1,300 tons emitted in 2000. (Table 8.) Collectively, the ten worst industrial PM polluters in the state emitted 5,300 tons of PM10 in 2000.

Air Pollution, Illness, and Death

Relatively small increases in airbone particulates can significantly increase the incidence of respiratory disease and death.

Scientists began investigating the link between air pollution, illness and death in response to a number of severe air pollution episodes that sickened and killed thousands of residents in the United States, England and Belgium between 1930 and 1952. Most of the early research looked the effects of very high pollution levels, but more recent inquiry has focused on how low-to-moderate levels of particulates and other air pollutants affect human health. In the past decade the amount of research in this area has exploded, as literally hundreds of studies have been conducted just on the relationship between particulates and death. The scientific consensus is undebatable: Particulates are significantly more harmful than previously realized, and levels well below current state and federal air quality standards can cause or contribute to death.

PM pollution has been linked to an array of respiratory ailments in children and adults, including chronic cough, chest pain, breathlessness, wheezing, phlegm, and chronic bronchitis. (Abbey et al. 1995a,b, Pope and Dockery 1991, Braun-Fahulander et al. 1992, Hruba et al. 2001, Zemp et al. 1999.) PM also affects overall lung functioning. Researchers have found that levels of PM commonly experienced by Californians are associated with small but significant decreases in the ability of both children and adults to take and hold deep breaths. (Hoek et al., 1998, Raizenne et al. 1996, Ackerman-Liebrich et al. 1997.)

Kids + PM = Damaged lungs

More troubling, PM can also retard the growth of children's lungs. The Children's Health Study, a long-term investigation of the health effects of air pollution conducted on more than 3,500 children from 12 communities in Southern California, found that PM10 and PM2.5 exposure was associated with decreases in both lung function and lung growth. (Peters et al. 1999, Gauderman et al. 2000.) A follow-up study found that children who moved to areas with lower PM levels showed increased lung growth and functioning, while lung growth and function continued to decline in those who moved to areas with even higher PM levels. (Avol et al. 2001.)

Wherever the link has been investigated, including many studies conducted in California, the results have been consistent: For every 10 micrograms of PM10 added to every cubic meter of air, symptoms of respiratory illness increase, with some studies showing increases of up to 40 percent. State scientists estimate that more than 13,500 current cases of chronic bronchitis in Californians

over the age of 27 are due to particulate air pollution. PM is also responsible for upper respiratory symptoms in an estimated 418,000 California children between the ages of 9 and 11, for lower respiratory symptoms in almost 400,000 children between the ages of 7 and 14, and almost five million lost days of work each year for PM-related illnesses[1]. (ARB/OEHHA 2001.)

Between 1980 and 1994 the prevalence of asthma in the United States increased by more than 75 percent. (Mannino et al., 1998.) Asthma now affects more than 10 million adults and almost five million children. While the current scientific consensus holds that PM pollution does not cause asthma, studies in California and elsewhere have repeatedly found that PM can significantly exacerbate the disease.

The state's proposed 24-hour particulate standards may not cover a short enough exposure period to fully protect public health.

Both PM2.5 and PM10 are associated with many different measures of the severity of asthma, including frequency of attacks, increased use of medication, emergency room visits and hospitalization. (Ostro 2001, Delfino 1998, Pope and Dockery 1992, Yu et al. 2000, Gielen et al. 1997.) A study of asthmatic African-American children in Los Angeles found that one-hour maximum levels, 24-hour averages, and multi-day averages of PM10 were all associated with increases in asthmatic symptoms. (Ostro et al 2001.) State scientists estimate that almost 600,000 asthma attacks, almost 4,000 emergency room visits and more than 1,600 hospital admissions each year are linked to PM-induced asthma.

PM is also associated with increased hospital visits for illnesses other than asthma. Research in dozens of cities in California and other states has consistently found that short-term PM10 and PM2.5 exposures are associated with hospital admissions for cardiovascular and pulmonary diseases such as heart attack, congestive heart failure, cardiac arrhythmia and chronic obstructive pulmonary disease. (Linn et al 2000, Moolgavkar 2000 a,b, Samet et al 2000a, Sheppard et al 1999, among others). Overall, these studies have found that for each 10-microgram increase in PM10 levels in a cubic meter of air, hospital admissions for cardiovascular and respiratory diseases rose by 1.25 to 5 percent. (ARB/OEHHA 2001.) This holds true in locations where PM10 pollution was at low to moderate levels, as well as where levels were high. Data for PM2.5 is more sparse, but suggests that incremental increases in fine particulates may be associated with even greater increases in hospital admissions.

State scientists estimate each year PM10 pollution is responsible for 2,100 hospital admissions for chronic obstructive pulmonary disease, 3,000 admissions for pneumonia and 5,500 admissions for cardiovascular diseases. These estimates account *only* for people age 65 and older, but research has found increases in hospital admissions for these illnesses among younger people as well. (Table 9.)

Common sense says that breathing polluted air daily over an extended period of time is more dangerous than exposure for a few hours or days. Observed increases in mortality from short-term PM exposures are three to four times lower than those from long-term exposures. (ARB/OEHHA 2001.) Yet the impact of short-term PM exposures on public health cannot be ignored. ARB cautions that annual PM averages “do not give an accurate indication of the

seasonal nature of emissions." (ARB 2001.) Averaging means that an area could meet annual standards but have significantly higher PM levels for part of the year, and acutely high levels for a few days of the year.

Shorter-term standard may be needed

A 24-hour standard may actually not be short *enough* to protect public health, as there is evidence that exposure to high levels of particulates over shorter time periods can have significant health effects. One study found that exposure for only two hours was associated with the onset of heart attack symptoms. (Peters et al. 2001.) ARB says it may consider shorter-term standards in the future.

In 1993, Harvard researchers published the results of a 16-year study of 8,000 people in six cities, which found that residents of the city with the highest levels of particulates had a 26 percent higher death rate than the people living in the least polluted city. (Dockery et al. 1993.) An even more extensive seven-year study conducted of more than 550,000 people in 151 metropolitan areas found that residents of cities with the highest PM10 had a 17 percent higher mortality rate than those residing in cities with the lowest levels. (Pope et al. 1995.) These long-term studies have convincingly shown that chronic exposure to particulate matter increases death rates, but recent research shows that short-term PM exposure also is associated with increased mortality.

"The evidence in support of an association between the concentration of particulate air pollution and the mortality rate is consistent."

– Dr. James Ware, Harvard School of Public Health.

Studies in over 200 cities worldwide – cities with significantly different climates, racial profiles, weather patterns, pollution sources and pollution severity – have found a consistent connection between *daily* PM levels and *daily* mortality rates. These studies accounted for numerous other factors such as smoking, age, poverty, weather and other pollutants. Dr. James Ware of the Harvard School of Public Health summarized the findings: "The evidence in support of an association between the concentration of particulate air pollution and the mortality rate is consistent, is not affected by differences in statistical methods, and can be generalized." (Ware 2000.)

In assessing the health risks of a given pollutant, the standard scientific assumption is that risks decrease as exposure rates decrease, and that no harmful effects occur below a certain threshold. But PM does not fit this model. Studies show that the relationship between PM concentration and death is not a tapering curve but a straight line – that is, the health effects of particulates are directly proportional to the level of exposure. No exposure level, including levels below current state and federal standards, has been found at which PM does not have a measurable effect on mortality. (Pope 2000, Daniels et al. 2000.) This has important implications for the development of state air quality standards, which are required to determine the level above which a pollutant is known to harm sensitive populations and incorporate a margin of safety to protect them. (ARB/OEHHA 2001.)

Environmental pollutants do not affect everyone equally, but have greater impact on the very young, the very old, the poor, and those with pre-existing illnesses. The highest rates of PM-related death are among the elderly, especially those with heart or lung diseases.

PM and SIDS

But research into PM's effects on infants and children has found links to pre-term birth or Sudden Infant Death Syndrome (crib death). Most of these studies have been conducted outside the U.S., but indicate a 2 to 4 percent increase in mortality for each 10 micrograms of PM10 in a cubic meter of air. (Loomis et al. 1999, Ostro et al. 1999a.) A study of 98,000 newborns in Southern California born between 1989 and 1993 concluded that the likelihood of pre-term birth was significantly associated with elevated PM levels during the six weeks before birth. (Ritz 2000.)

Some critics argue that PM-related mortality is not a major public health concern, because most deaths are of people who are already ill and only shorten life by days or weeks. Yet in recent years scientists who have thoroughly investigated this notion found it wasn't true. For instance, studies have found that out-of-hospital deaths are between two and four times more strongly related to PM pollution than in-hospital deaths. This indicates that it is not just the critically ill who are more likely to die on days of high PM exposure. (Schwartz 2000, 2001b.) Addressing this issue, the ARB and OEHHA say PM-related mortality is "not the result of just a few days of life shortening . . . it appears that significant reductions in life expectancy may be involved." (ARB/OEHHA 2001.)

Not all particles are created equal. Research indicates that people are much less sensitive to dust and particulates from other natural sources than industrial emissions and auto exhaust. Two studies have found that exposure to particles derived from motor vehicles, coal combustion, and iron and steel manufacturing was significantly associated with daily mortality, while exposure to particles from soil was either not associated or less significantly associated with increased mortality. (Laden et al. 2000, Ozkaynak and Thurston 1987.) Another study was conducted after researchers in Utah noted that hospital admissions and deaths declined following the temporary shutdown of a local steel mill. (Pope 1989.) Scientists then exposed rats to a constant amount of particulates collected before, during and after the mill's closure and found that animals exposed to particulates collected while the mill was closed showed much lower rates of lung damage and related symptoms. (Dye et al. 2001.) The policy implications are clear: The largest sources of particulates, such as road dust, may not be as harmful as particulates from smaller sources such industrial emissions or auto exhaust.

PM-related illnesses carry significant economic impacts. For example, hospital visits for PM-induced COPD, pneumonia and cardiovascular diseases in the population aged 65 and over and visits for pollution-induced asthma in the population under 65 total $132 million a year (Table 3). PM-related illnesses cause Californians to miss almost 5 million work days a year, costing the state's economy more than $880 million[2]. Considering just these costs, the

price of PM air pollution in California exceeds $1 billion a year. (Table 3.) This does not take into consideration many hospital and non-hospital costs of other minor and serious PM-related illnesses.

If California's air quality met the proposed PM standards, an estimated $584 million could be saved each year, cutting the costs of particulate air pollution by more than half. (Table 3.) And if lower standards were reached, these costs would be reduced even further. By achieving a mean ambient PM10 level of 15 micrograms per cubic meter – just 5 micrograms less than the proposed standards – an additional $200 million would be saved each year.

Proposed state standards would prevent hundreds of thousands of asthma attacks each year.

Footnotes

[1] The studies on which OEHHA based their estimates of PM-related illnesses only looked at certain age groups. OEHHA/ARB decided not to extrapolate the results to other age groups and, instead, estimated the illness figures for only these same age groups.

[2] The median per-day income of California residents in the year 2000 was $180 (=46,802 / 260). (US Census Bureau 2000) The actual number of work days lost to PM10-related illness is 4,910,652. (OEHHA/ARB 2001) The estimated cost to the state's economy is the product of these two numbers.

Particle Civics

California has long been a national and global leader in pioneering efforts to improve air quality to protect public health. California developed the nation's first vehicle emission control program in 1963, instituted the nation's first heavy-duty diesel truck standards in 1973, and was the first state to sell unleaded gasoline in 1976. California has also been a trendsetter in developing health-based ambient air quality standards that reflect the most current science available. The existing PM10 standards are a perfect example.

California is the first state to require that air pollution standards be tough enough to protect children, rather than adult males.

In the late 1970s, ARB scientists were among the first to recognize that particulates with diameters of 10 microns or less (PM10) posed more of a human health risk than those with larger diameters. At that time, state and federal air quality standards treated this highly diverse group of compounds as one category called total solid particulates (TSP). But the ARB determined that separate standards were needed for PM10, which took effect in 1982. It took five more years for the U.S. EPA to follow suit, but the federal standards were set 1.5 to three times weaker than the state standards.

Since then, entire libraries of research on particulates and health have been published. There is no disagreement in the scientific and regulatory committees: PM has more profound negative effects on human health than ever before realized, and these effects are measurable at concentrations at or below current air quality standards. This research has established that particles with diameters less than 2.5 microns, or PM2.5, may be particularly hazardous to human health, making the need for tougher and more comprehensive standards more urgent.

Priority: Protecting kids

The need for a revision of California's particulate standards was highlighted with the passage of the Children's Environmental Health Protection Act of 1999 (SB 25 by State Sen. Martha Escutia.) As part of the Act, the ARB and OEHHA were required to review all existing health-based ambient air quality standards in California to determine whether they protected infants and children, as well as other sensitive populations, with a sufficient margin of safety. During this review, it became clear that the current levels of particulate matter in California were responsible for significant and measurable health effects, not

only on children but the public as a whole. As result, the agencies made PM standards the top priority for revision.

In December of 2001 the agencies proposed that California's annual mean PM10 standard be lowered by a third, and added a new standard for PM2.5 that is slightly more stringent than the corresponding federal standard. They recommended leaving the short-term standard for PM10 at current levels, and opted not to recommend establishment of a short-term standard for PM2.5. However, after criticism from an independent scientific review panel and pressure from the environmental community, ARB and OEHHA proposed a short-term standard for PM2.5 that is more than twice as stringent as the existing federal standard. (Figures 1 and 2.)

How many people will California allow to die or become ill each year from the very air they breathe?

The proposed annual standards would dramatically reduce the number of air pollution-related health problems in California. If these standards were attained, thousands of deaths and injuries would be prevented each year: 6,525 premature deaths, 6,903 hospital admissions for respiratory illness, 2,301 emergency room visits for asthma, 7,835 cases of chronic bronchitis, and 338,270 asthma attacks. **(Table 9.)** Overall, the number of PM10-induced illnesses and deaths would decrease by an average of 60 percent, and PM2.5 illnesses and deaths would be cut in half. Because these figures account only for certain illnesses and age groups, the actual health benefits of reducing PM levels would be even greater.

How many will die?

If the standards were set at levels slightly more stringent than those being proposed by the ARB, even more lives would be saved and illnesses avoided. For example, if California met an annual mean PM10 standard of 15 $\mu g/m^3$ and an annual mean PM2.5 standard of 10 $\mu g/m^3$ an additional 1,900 premature deaths, 2,700 respiratory hospital admissions, 850 emergency room visits for asthma, 3,000 cases of chronic bronchitis, and 127,000 asthma attacks could be avoided each year. Overall, PM-induced deaths and illnesses would drop by almost 80 percent.

The consequences of moving in the other direction, toward less stringent standards advocated by the oil and auto industries, would be deadly. EWG analysis shows that if the annual PM10 standard was weakened only slightly from proposed levels, to 28 $\mu g/m^3$, and the annual PM2.5 standard was set to correspond with the federal standard of 15 $\mu g/m^3$, there would be 4,000 more premature deaths, 3,000 more hospital admissions, 1,000 more emergency room visits for asthma, 3,500 more cases of chronic bronchitis, and 150,000 more asthma attacks each year. The question facing the ARB board next month is grim: How many people will California allow to die or become ill each year from the very air they breathe?

Table 9. Savings from Reducing PM-related Illnesses.

PM2.5

	Ages Considered	Number at current annual average PM2.5 level	Cost at current level (1999 $)	Number if proposed standard achieved	Number fewer if proposed standard was achieved	Percent fewer	Dollars saved if proposed standard was achieved	Additional number saved if proposed standard was tightened to 10 ug/m3	Additional dollars saved if standard was tightened to 10 ug/m3
Long-term Mortality [1]	30+	9,390	-	2,865	6,525	69%	-	1,895	-
Short-term Mortality	All	4,011	-	2,066	1,945	48%	-	573	-
Chronic Bronchitis [2]	27+	11,409	N/A	5,660	5,749	50%	N/A	1,612	N/A
Chronic Obstructive Pulmonary Disease Hospital Admissions [3]	65+	1,243	$14,575,966	642	601	48%	$7,529,519	179	$2,098,238
Pneumonia Hospital Admissions [4]	65+	1,791	$24,947,738	927	864	48%	$12,914,520	258	$3,593,682
Cardiovascular Disease Hospital Admissions [5]	65+	3,173	$19,999,436	1,646	1,527	48%	$10,376,736	456	$2,874,168
Asthma Hospital Admissions [6]	64-	950	$16,912,004	481	470	49%	$8,550,392	133	$2,366,602
Asthma Emergency Room Visits [7]	64-	2,352	$703,156	1,185	1,167	50%	$348,933	330	$98,670
Work Loss Days [8]	64-	2,923,535	$526,236,300	175,151	1,445,535	49%	$260,196,300	354,479	$63,806,290
Total			$603,374,599				$299,916,400		$74,837,650

PM10

	Ages Considered	Number at current annual average PM10 level	Cost at current level (1999 $)	Number if proposed standard achieved	Number fewer if proposed standard was achieved	Percent fewer	Dollars saved if proposed standard was achieved	Additional number saved if proposed standard was tightened to 15 ug/m^3	Additional dollars saved if standard was tightened to 15 ug/m3
Long-term Mortality [9]	30+	7,470	-	978	6,492	87%	-	N/A	-
Short-term Mortality	All	4,063	-	1,772	2,291	56%	-	N/A	-
Chronic Bronchitis [10]	27+	13,530	N/A	5,696	7,835	58%	N/A	2,902	N/A
Chronic Obstructive Pulmonary Disease Hospital Admissions [11]	65+	2,115	$24,792,990	923	1,192	56%	$10,815,492	463	$5,427,286
Pneumonia Hospital Admissions [12]	65+	3,061	$42,639,263	1,340	1,721	56%	$18,664,007	671	$9,346,359
Cardiovascular Disease Hospital Admissions [13]	65+	5,452	$34,362,621	2,395	3,057	56%	$15,096,981	1,195	$7,532,085
Asthma Hospital Admissions [15]	64-	1,624	$28,904,937	692	933	57%	$12,311,563	346	$6,156,724
Asthma Emergency Room Visits [15]	64-	3,992	$1,193,527	1,691	2,301	58%	$687,999	850	$254,150
Work Loss Days [16]	64-	4,910,652	$883,917,360	254,466	2,814,815	57%	$506,666,700	953,659	$171,658,534
Total			$1,015,810,698				$564,242,742		$200,375,138

Source: ARB/OEHHA 2001, EWG 2002, Abt 2000, US Census 2000.

Notes - Table 9

1) The reason why the number of PM2.5-related deaths is higher than the number of PM10-related deaths even though PM2.5 particles are a subset of PM10 particles is related to the study which ARB/OEHHA based their calculations of long-term mortality. This study (Krewski et al. 2000) found long-term mortality to be assocaited only with the fine (PM2.5) fraction of PM10. Although the other major long-term mortality study (Dockery et al. 1993) did find an association between chronic exposure and mortality, ARB/OEHHA decided to based their calculations on the Krewski et al. (2000) study. See ARB/OEHHA 2001 for futher details.

2) The costs related to chronic bronchitis could not be calculated.

3) Hospital charge cost only. Mean hospital stay is 6.02 days with a mean charge of $11,722 (1999 dollars). (Abt 2000)

4) Hospital charge cost only. Mean hospital stay is 7.01 days with a mean charge of $13,929 (1999 dollars). (Abt 2000)

5) Hospital charge cost only. Mean hospital stay is 5.44 days with a mean charge of $17,794 (1999 dollars). (Abt 2000)

6) Hospital charge cost only. Mean hospital stay is 3.03 days with a mean charge of $6,303 (1999 dollars). (Abt 2000)

7) The average asthma ER visit cost is $299 (1999 dollars). (Abt 2000)

8) The median per-day income of California residents in the year 2000 was $180. (US Census 2002)

9) The number of PM10 related deaths at an annual average of 15 ug/m3 was not calculated because no studies have been done on mortality where PM10 is less than 18; as a result OEHHA/ARB uses 18 ug/m3 as background level.

10) The costs related to chronic bronchitis could not be calculated.

11) Hospital charge cost only. Mean hospital stay is 6.02 days with a mean charge of $11,722 (1999 dollars). (Abt 2000)

12) Hospital charge cost only. Mean hospital stay is 7.01 days with a mean charge of $13,929 (1999 dollars). (Abt 2000)

13) Hospital charge cost only. Mean hospital stay is 5.44 days with a mean charge of $17,794 (1999 dollars). (Abt 2000)

14) Hospital charge cost only. Mean hospital stay is 3.03 days with a mean charge of $6,303 (1999 dollars). (Abt 2000)

15) The average asthma ER visit cost is $299 (1999 dollars). (Abt 2000)

16) The median per-day income of California residents in the year 2000 was $180. (US Census 2002)

Who's Against Clean Air?

Lobbyists for the petrochemical industry, automakers and engine manufacturers have mounted a major campaign against the PM standards proposed by the Air Resources Board and Office of Environmental Health Hazard Assessment. The dirty-air lobby includes the Alliance of Auto Manufacturers, representing 13 U.S. and international automakers; Western States Petroleum Association, representing 36 oil companies; and the Engine Manufacturers Association, representing 27 companies. Individual corporations include ExxonMobil, General Electric and BP (formerly British Petroleum) ranked by *Forbes* as the second, third and fourth most powerful corporations in the world.

Oil companies and automakers opposed to cleaner air gave Gov. Davis $175,000 in the current election cycle.

According to records filed with the California Secretary of State, 22 industry associations and individual companies opposed to tougher particulate standards spent more than $7.5 million in 2001 on lobbying at the State Capitol. (Table 10.) Most of these associations and companies have full-time lobbyists in Sacramento or are represented by one or more lobbying firms, some of whom employ whole teams of lobbyists. Their lobbying activity is in addition to hundreds of thousands of dollars in campaign contributions to state politicians made by the associations and companies each year. Just three members of the Western States Petroleum Association – BP, Occidental Petroleum and Chevron Texaco— collectively gave $175,000 to Gov. Gray Davis in 2000-2001. (Cal-Access 2002.)

The truth behind the smokescreen

Here's a sampling of their arguments against cleaner air, and the truth behind the smokescreen:

- The Alliance of Auto Manufacturers and Engine Manufacturers Association claim the proposed tougher standards will not "result in any greater protection of public health than the current California standards." (AAM 2002.) But the peer-reviewed risk assessment by state scientists found that attaining the "recommended standards would result in a reduction of . . . about 3 percent of all mortality in the population above age 30." (ARB/OEHHA 2001.)

- According to the Western States Petroleum Association, "as much or more public health benefit would be gained from uniform reduction targets than from a single statewide standard." (WSPA

2002.) But because the heaviest particulate pollution is found in lower-income communities of color, such a policy would perpetuate existing environmental inequities"– as if people who live in highly polluted areas have less right to clean air.

- Ford Motor Co. says the proposed standards are "impossibly stringent . . . with practically no hope of attainment." (Ford 2002.) It is hard to take this claim seriously when the auto industry's estimates of the cost of complying with other recent air quality regulations have been inflated by a factor of 14. (Browner 1997.)

Residents of communities of color, who are more likely to breathe dangerous levels of particulate pollution, would benefit most from cleaner air.

The attack on California's proposed particulate standards is a rerun of the same special interests' efforts to derail tough standards at the federal level.

In 1996, the U.S. EPA proposed for the first time to regulate PM2.5, after research had shown strong links between fine particles and death. The EPA proposed to cut allowable levels of PM2.5 in half, saving an estimated 35,000 lives a year nationwide. In California those standards would have saved an estimated 2,500 lives. In reviewing the EPA's 1997 proposal, the Air Resources Board went further, recommending an even tougher PM2.5 standard that would have saved an estimated 3,000 to 4,000 additional lives in the state.

Even before the EPA and ARB announced their proposals, more than 650 industry associations and companies banded together as the Air Quality Standards Coalition. The coalition included the National Association of Manufacturers, American Petroleum Institute, American Automobile Manufacturers Association, Chemical Manufacturers Association, Edison Electric Institute, National Mining Association, American Forest and Paper Association, and American Trucking Association.

Goodbye to barbecues?

The coalition spent $1.5 million on a nationwide lobbying and misinformation campaign, and millions more on industry-funded "sound science" to undermine the peer-reviewed science relied on by the EPA. They spread exaggerated claims about how the proposed standards would impact the American way of life –for example, forcing an end to backyard barbecues. (Skrzycki 1996) A fake "grassroots" group called Citizens for a Sound Democracy targeted African-Americans and Latinos, warning that the cost of new standards was too high for small minority-owned businesses. (Washington Post 1996.)

To the contrary, in 1997 EWG found that residents of communities of color in California would benefit the most from tougher PM standards, because people in communities of color were nearly three times more likely to breathe dangerous levels of PM pollution than Californians living in predominantly white communities. Based on then-current population and pollution data, residents of communities of color had a 54 percent chance of breathing unsafe levels of particulates, compared to a 19 percent chance for predominantly white communities. (EWG 1997a.)

After the standards were adopted by the Clinton Administration, the American Trucking Association challenged them in court, claiming that EPA had overstepped its authority in setting the regulations and that the agency should consider the cost of compliance as well as the benefits to public health. ATA's arguments were dismissed by the U.S. Supreme Court in 2001. The ruling stated that the law clearly established the agency's right to set standards and that the Act "unambiguously bars cost considerations." But the Supreme Court also sent parts of the case back to the U.S. Court of Appeals for clarification. In March 2002 the appeals court affirmed its ruling that "EPA must err on the side of caution – setting the [standards] at whatever level it deems necessary and sufficient to protect the public health with an adequate margin of safety, taking into account both the available evidence and the inevitable scientific uncertainties."

The unanimous appeals court ruling ended five years of counterattack by the opponents of cleaner air. In that period, according to EPA's estimates, 175,000 Americans died from PM pollution whose lives would have been saved or extended if air quality goals represented by the proposed standards had been achieved.

Table 10. Opponents of new PM standards spent almost $7.5 million to lobby against cleaner air in 2001.

	Lobbying Expenditures 2001	Contributions to Gov. Davis, current election cycle
Western States Petroleum Association	$2,137,100	
BP America	$1,253,634	$80,000
Chevron Texaco	$760,456	$35,000
General Motors Corporation	$549,434	
Equilon Enterprises	$521,600	
Ford Motor Company	$418,742	
Phillips Petroleum	$396,143	
General Electric	$255,774	
Nuevo Energy Company	$174,207	
Alliance of Automobile Manufacturers, Inc.	$161,790	
Aera Energy LLC	$151,466	
Occidental Petroleum	$135,225	$60,000
Ultramar Diamond Shamrock Corp.	$120,983	
Exxon Mobil	$112,937	
Toyota Motor Sales, U.S.A., Inc.	$85,673	
DaimlerChrysler Corporation	$51,213	
Kinder Morgan Energy Enterprises	$44,921	
Caterpillar Inc.	$41,735	
Deere and Company	$36,348	
Nissan North America	$25,156	
Venoco Inc.	$3,000	
TOTAL	$7,437,537	$175,000

Source: Compiled from lobbying and campaign finance reports as filed with the California Secretary of State. Available at http://CAL-ACCESS.ss.ca.gov

References

Ackermann-Liebrich U, L Philippe, J Schwartz, C Schindler, C Monn, G Bolognini, JP Bongard, O Brandli, G Domenighetti, S Elsasser, L Grize, W Karrer, R Keller, H Keller-Wossidlo, N Kunzli, BW Martin, TC Medici, AP Perruchoud, MH Schoni, JM Tschopp, B Villiger, B Wuthrich, JP Zellweger, and E Zemp. 1997. Lung function and long term exposure to air pollutants in Switzerland. Study on Air Pollution and Lung Diseases in Adults (SAPALDIA) Team. Am J Respir Crit Care Med. 155(1):122-9.

Abbey DE, BE Ostro, F Petersen, and RJ Burchette. 1995a. Chronic respiratory symptoms associated with estimated long-term ambient concentrations of fine particulates less than 2.5 microns in aerodynamic diameter (PM2.5) and other air pollutants. J Expo Anal Environ Epidemiol 5(2):137-59.

Abbey DE, BE Ostro, G Fraser, T Vancuren, and RJ Burchette. 1995b. Estimating fine particulates less than 2.5 microns in aerodynamic diameter (PM 2.5) from airport visibility data in California. J Expo Anal Environ Epidemiol 5:161-80.

Abt. Associates, Inc. 2000. The Particulate-Related Health Benefits of Reducing Power Plant Emissions. Prepared for Clean Air Task Force. Bethesda, MD.

Air Resources Board. 2001. The 2001 California almanac of emissions and air quality. ARB Planning and Technical Support Division. Draft. November 30, 2001. California Environmental Protection Agency.

Air Resources Board. 2000. 2000 Emission Inventory. http://www.arb.ca.gov/emisinv/emsmain/ emsmain.htm.

Air Resources Board. 2000. Risk Reduction Plan for Diesel PM Emissions. Draft. July 13 2000.

Air Resources Board and Office of Environmental Health Hazard Assessment. 2000. Adequacy of California's Ambient Air Quality Standards: Senate Bill 25 – Children's Environmental Health Protection. Draft. Sept. 12, 2000

Air Resources Board and Office of Environmental Health Hazard Assessment. 2001. Review of the California Ambient Air Quality Standards for Particulate Matter and Sulfates. Report to the Air Quality Advisory Committee.

Alliance of Auto Manufacturers. 2002. Review and critique of CalEPA November 30, 2001 Public Review Draft. Jan. 10, 2002.

Avol EL, WJ Gauderman, SM Tan, SJ London, JM Peters. 2001. Respiratory effects of relocating to areas of differing air pollution levels. Am J Respir Crit Care Med. 164 (11):2067-72.

Braun-Fahrlander C, U Ackermann-Liebrich, J Schwartz, HP Gnehm, M Rutishauser, HU Wanner. 1992. Air pollution and respiratory symptoms in preschool children. Am Rev Respir Dis. 145(1):42-7

Browner, C. M. 1997. Oral Testimony of Carol M. Browner, Administrator, US Environmental Protection Agency, before the Senate Committee on Environment and Public Works. February 12, 1997.

California Department of Health Services. 1999. Major causes of death and death rates by race/ethnicity. Table 5-11. Center for Health Statistics. http://www.dhs. cahwnet.gov/hisp/chs/OHIR/vssdata/1999 Data/ 99Ch5Excel/ 5-11-1999Pre.xls

Daniels MJ, F Dominici, JM Samet, SL Zeger. 2000. Estimating particulate matter-mortality dose-response curves and threshold levels: an analysis of daily time-series for the 20 largest US cities. Am J Epidemiol. 152(5): 397-406.

Delfino, RJ, RS Zeiger, JM Seltzer, and DH Street. 1998. Symptoms in pediatric asthmatics and air pollution: differences in effects by symptom severity, anti-inflammatory medication use and particulate averaging time. Environmental Health Perspectives. 106: 751-761.

Dockery DW, CA Pope III, X Xu, JD Spengler, JH Ware, ME Fay, et al. 1993. An association between air pollution and mortality in six US cities. New England Journal of Medicine. 329:1753-9.

Dye JA, JR Lehman, JK McGee, DR Winsettm, AD Ledbetter, JI Everitt, AJ Ghio, and DL Costa. 2001. Acute pulmonary toxicity of particulate matter filter extracts in rats: coherence with epidemiologic studies in Utah valley residents. Environmental Health Perspectives. 109 (Suppl 3): 395-403.

Environmental Working Group. 1997. Smokestacks and smokescreens. Big polluters, big profits and the fight for cleaner air. Washington, DC. www.ewg.org/reports/smoke

Environmental Working Group. 1997a. People of Color in California Breathe the Most Heavily Polluted Air. Washington, DC. www.ewg.org/reports/caminority/caminority.html

Ford Motor Company. 2002. Untitled comments on ARB/OEHHA Public Review Draft of Nov. 30, 2001. January 9, 2002.

Gauderman WJ, R McConnell, F Gilland, S London, D Thomas, E Avol, H Vora, K Berhane, EB Rappaport, F Lurmann, HG Margolis, and J Peters. 2000. Association between air pollution and lung function growth in southern California children. Am J Respir Crit Care Med. 162 (4 Pt 1):1383-90.

Gielen MH, SC van der Zee, JH van Wijnen, CJ van Steen, and B Brunekeef. 1997. Acute effects of summer air pollution on respiratory health of asthmatic children. Am J Respir Crit Care Med. 155:2105-8.

Grossi M. 2002. Officials pull Valley air plan Move is intended to avoid delay of road-project funds. The Fresno Bee. February 22, 2002.

Hoek G, DW Dockery, CA Pope III, LM Neas, W Roemer, and B Brunekreef. 1998. Association between PM10 and decrements in peak expiratory flow rates in children: reanalysis of data from five panel studies. Eur Respir J. 11:1307-11.

Hruba F, E Fabianova, K Koppova, JJ Vandenberg. 2001. Childhood respiratory symptoms, hospital admissions, and long-term exposure to airborne particulate matter. J Expo Anal Environ Epidemiol. 11(1):33-40.

Krewski D, R Burnett, MS Goldberg, K Koover, J Siemiatycki, M Jerrett et al. 2000. Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality. Res Rep Health Eff Inst (A special report of the Institute's Particle Epidemiology Reanalysis Project).

Laden F, LM Neas, DE Dockery, and J. Schwartz. 2000. Association of fine particulate matter from different sources with daily mortality in six US cities. Environmental Health Perspectives. 108 (10): 941-947.

Loomis D, M Castillejos, DR Gold, W McDonnell, and VH Borja-Aburto. 1999. Air pollution and infant mortality in Mexico City. Epidemiology. 10(2):118-23.

Linn WS, Y Szlachcic, H Gong Jr., PL Kinney, and R Zweidinger. 2000. Air pollution and daily hospital admissions in metropolitan Los Angeles. Environmental Health Perspectives. 108:427-34.

Mannino DM, DM Homa, CA Pertowski, A Ashizawa, LL Nixon, CA Johnson, LB Ball, E Jack, and DS Kang. 1998. Surveillance for asthma—United States, 1960-1995. Mor Mortal Wkly Rep CDC Surveill Summ. 47(1):1-27.

Moolgavkar, S.H. 2000a. Air pollution and daily mortality in three US counties. Environmental Health Perspectives. 108(8): 777-84.

Moolgavkar, S.H. 2000b. Air pollution and hospital admissions for diseases of the circulatory system in three US metropolitan areas. Journal of the Air & Waste Management Association 50: 1199-1206.

Ostro, B, M Lipsett, J Mann, H Braxton-Owens and M White. 2001. Air pollution and exacerbation of asthma in African-American children in Los Angeles. Epidemiology 12(2): 200-208.

Ostro BD, L Chestnut, V Nuntavarn, and L Adit. 1999. The impact of particulate matter on daily mortality in Bangkok, Thailand. Journal of the Air & Waste Management Association 49:100-7.

Ozkaynak H and GD Thurston. 1987. Associations between 1980 U.S. mortality rates and alternative measures of airborne particle concentration. Risk Anal. 7:449-461.

Pope CA III. 2000. Epidemiology of fine particulate air pollution and human health: biologic mechanisms and who's at risk? Environmental Health Perspectives. 108(Supp 4): 713-23.

Pope CA. 1989. Respiratory disease associated with community air pollution and a steel mill, Utah Valley. Am J Public Health. 79: 623-628.

Pope CA III, MJ Thun, MM Namboodiri, DW Dockery, JS Evans, Fe Speizer et al. 1995. Particulate air pollution as a predictor of mortality in a prospective study of US adults. Am J Respir Crit Care Med. 151:669-74.

Pope CA III and DW Dockery. 1992. Acute health effects of PM10 on symptomatic and asymptomatic children. Am Rev Respir Dis. 145: 1123-8.

Pope CA III, DW Dockery, J Spenglerf, ME Raizenne. 1991. Respiratory health and PM10 pollution- a daily time series analysis. American Review of Respiratory Diseases. 144:668-74.

Peters A, DW Dockery, JE Muller, and MA Mittleman. 2001. Increased particulate air pollution and the triggering of myocardial infaction. Circulation 103: 2810-5.

Peters JM, E Avol, WJ Gauderman, WS Linn, W Navidi, SJ London, H Margolis, E Rappaport, H Vora, H Gong, Jr, and DC Thomas. 1999. A study of twelve Southern California communities with differing levels and types of air pollution. II. Effects on pulmonary function. Am J Respir Crit Care Med. 159(3):768-75.

Raizenne, M., L.M. Neas, A.I. Damokosh, D.W. Dockery, J.D. Spengler, P. Koutrakis, J.H. Ware, and F.E. Speizer. 1996. Health symptoms of acid aerosols on North American children: Pulmonary function. Environmental Health Perspectives 104(5): 506-514.

Ritz, B, F Yu, G Chapa, and S Fruin. 2000. Effect of air pollution on preterm birth among children born in Southern California between 1989 and 1993. Epidemiology 11(5): 502-511.

Samet JM, SL Zeger, F Dominici, F Curriero, I Coursac, DW Dockery et al. 2000. The national morbidity, mortality, and air pollution study. Part II: Morbidity

and mortality from air pollution in the United States. Res Rep Health Eff Inst (94 Pt 2):5-79.

Schwartz J. 2001a. Air pollution and blood markers of cardiovascular risk. Environmental Health Perspectives. 109(Suppl 3): 405-9.

Schwartz J. 2001b. Is there harvesting in the association of airborne particles with daily deaths and hospital admissions? Epidemiology. 12(1):55-61.

Schwartz J. 2000. Harvesting and long term exposure effects in the relationship between air pollution and mortality. Am J Epidemiology. 151:440-8.

Sheppard, L., D. Levy, G. Norris, T. Larson, and J. Koenig. 1999. Effects of ambient air pollution on nonelderly asthma hospital admissions in Seattle, WA, 1987-1994. Epidemiology 10(1): 23-30.

U.S. Census Bureau. 2000. Income 2000. Median Household Income by State. http://www.census.gov/hhes/income/income00/statemhi.html

U.S. Environmental Protection Agency. 1996. Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information: OAQPS staff paper. Office of Air Quality Planning and Standards, Research Triangle Park, NC, EPA-452\R-96-013.

Ware, JA. 2000. Particulate air pollution and mortality- Clearing the air. The New England Journal of Medicine. 343(24): 1798-1799.

Western States Petroleum Association. 2002. Comments on the California Environmental Protection Agency November 30, 2001 draft report. A report to the Western States Petroleum Association [from] Exxon Mobil Biomedical Sciences, Inc. Jan. 11, 2002.

Whitman, David. 2001. Fields of Fire. U.S. News & World Report, September 3, 2001.

Yu O, L Sheppard, T Lumley, JQ Koenig, and GG Shapiro. 2000. Effects of ambient air pollution on symptoms of asthma in Seattle-area children enrolled in the CAMP study. Environmental Health Perspectives. 108(12): 1209-14.

Zemp, E, S Elsasser, C Schindler, N Kunzli, AP Perruchoud, et al. 1999. Long-term ambient air pollution and respiratory symptoms in adults (SAPALDIA Study). Am J. Respir. Crit. Care Med. 159: 1257-1266.