Clean Air for California:

Cutting Health-Threatening Air Pollution 50% by 2010

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Acknowledgments

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Executive Summary

Despite progress, California has the worst air quality in the nation. Recognizing that air pollution threatens public health, Governor Schwarzenegger has made a bold promise to clean up California's air, committing to reduce health-threatening air pollution by 50% by 2010. While programs currently in place will make progress to clean the air by 2010, achieving the Governor's goal of a 50% reduction will be impossible without substantial new commitments to clean air programs. This report provides an assessment of anticipated shortfalls and suggests further action the state can take to help achieve the Governor's goal.

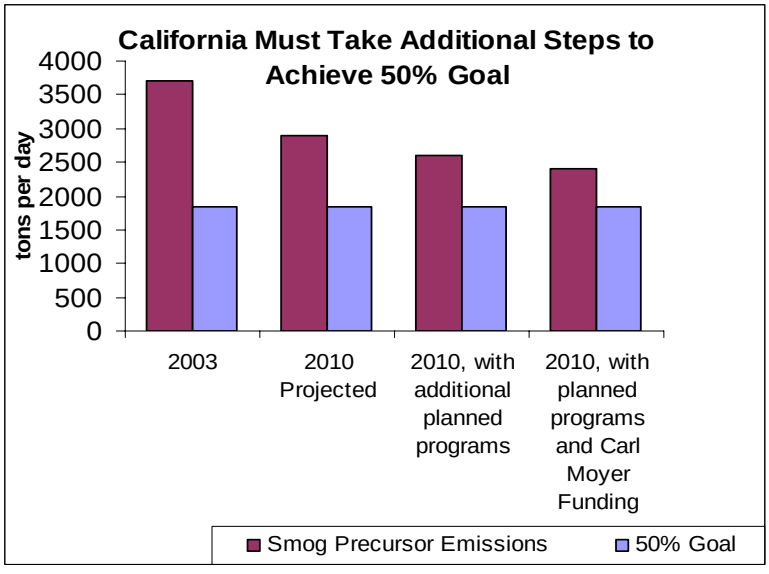
Current Programs Will Reduce Health-Threatening Pollution—But Not Enough

Smog-Forming Pollution--Current Programs Will Fall 40% Short of the Governor's Goal

We examined projected emissions of smog precursors from ten source categories highlighted in State Implementation Plans for cleaning up ozone. We found that:

- Key programs already on the books in the state are projected to reduce statewide emissions of smog precursors (nitrogen oxides and reactive organic gases) from these categories by 22% from current levels by 2010.
- Additional "near-term" measures proposed in the State Implementation Plan could achieve an additional 8% reduction in smog precursor emissions from 2003 levels.
- Combined, current and proposed measures would only achieve 30% reductions in smog precursor emissions from 2003 levels by 2010, cutting 1,100 tons per day (tpd) of emissions from a 2003 total for these categories of 3,700 tpd—short of the Governor's goal of reducing emissions 50%. (See **Figure ES-1**)

Figure ES-1



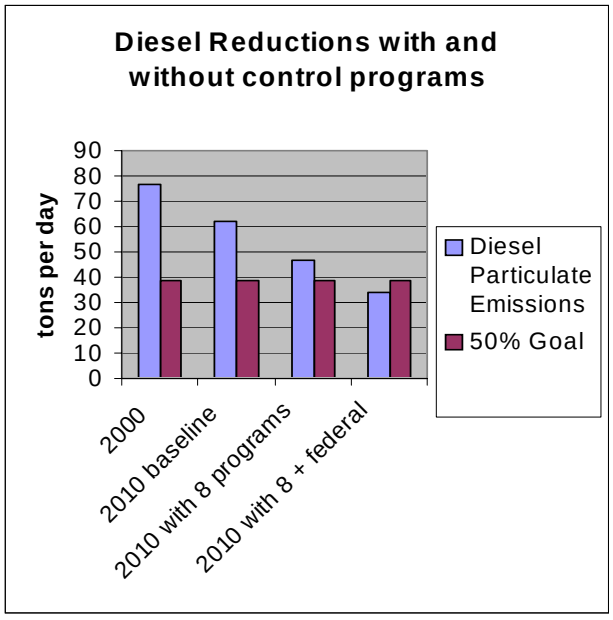
Diesel Particulate Pollution--Current Plans Rely Too Heavily on Federal Action

We examined projected emissions reductions from programs included in the state's ambitious diesel risk reduction plan. The plan includes programs that have been adopted but not fully implemented, including:

- Low-sulfur diesel fuel standards;
- the Lower-Emission School Bus Program; and
- Cleaner offroad engines (i.e. lawnmowers and construction equipment).

We found that the state plan relies heavily on two federal programs to achieve 50% reductions in diesel particulate emissions. Without these federal programs to clean up airplane and locomotive emissions, the state would fall short of the 50% goal. (See **Figure ES-2.**)

Figure ES-2



Recommendation: Additional Steps Must Be Taken to Get to 50% by 2010:

Planned pollution controls will achieve only a portion of the 50% pollution reduction goal. Additional efforts that can help fill the gap will be necessary. The state should consider adopting:

1. Incentives to Accelerate the Transition to Cleaner Vehicles

Incentives can play an important role in accelerating a transition to cleaner, safer engines, achieving 200 tpd of smog-forming emissions reductions by 2010.

- Carl Moyer Funding of $300 million annually over the next five years could result in 200 tpd less smog-forming emissions and a more than 10 tpd reduction in diesel particulate emissions by 2010.

- Low Emission School Bus Funding of $35.5 million annually for the next 5 years could help replace every pre-1977 school bus and retrofit every 1977-1987 model year school bus with diesel particulate filters. Most recently (FY02-03) only $4.92 million was available for this purpose.
- These incentives could be funded by other smog reduction programs not currently in the state plan, such as congestion pricing in major metropolitan areas, an increase in vehicle licensing fees, or a fee on emissions or miles traveled.

2. Programs to Reduce gasoline consumption and VMT growth:

We found that even with stronger standards for new cars and trucks, onroad mobile sources are projected to be responsible for more than one-third of all statewide smog precursor emissions in 2010, in part due to continued growth in vehicle miles traveled (VMT).

If the state adopted programs to slow projected VMT growth by 50%, we estimate 100 tpd or more of smog pollution could potentially be averted. Such programs could include vehicle emissions fees, mass transit investment, and land use policy.

In addition, broader efforts to stabilize gasoline and diesel fuel consumption at current levels could help control emissions growth in the mobile sources sector.

3. Stopping Federal Rollbacks and Advocating Strong New Federal Measures Are Also Important

- Achieving the Governor's Healthy Air Goal for smog by 2010 will require accelerating progress in achieving federal air quality standards for ozone, despite a U.S. EPA decision that would allow such progress to be delayed beyond the original 2010 deadline.
- Achieving the Healthy Air Goal for diesel particulates with the current plan relies heavily on clean-up of sources under federal jurisdiction (locomotives and airplanes). Such sources represent 45% of the potential emissions reductions achievable under the plan. Therefore, successful advocacy for federal regulation or additional, unidentified measures will be necessary to cut diesel pollution by 50%.

Why Achieving the 50% Goal Matters

While cutting levels of smog-precursor emissions and diesel particulates in half by 2010 will require substantial commitment from state leaders and the public, this investment will reap returns in improved public health and quality of life for all those who live, work, and grow up in the state of California. Without taking this step, severe pollution levels will continue to threaten public health in the state:

Smog

- In 2003 alone, 120 pounds of smog pollution were emitted by manmade sources for each resident of the state of California—equivalent to 5,900 tons per day.
- Nine of the 10 counties nationwide with the worst ozone levels are located in California.
- 5.5 million of the state's children live in areas with air quality that fails federal health standards for ozone. Pediatric asthma has skyrocketed in recent years, and recent studies have documented that exposure to ozone not only exacerbates asthma, but also can actually cause children to develop asthma.

Diesel Particulates

- In 2000, manmade sources emitted 28,000 tons of diesel particulates statewide.
- Californians face a significant elevated cancer risk from breathing outdoor air with high levels of diesel particulates. Exposure to diesel particulates—if it continues at current levels—will cause 16,000 additional lifetime cancers in California.

Introduction

"Breathing clean and healthy air is a right of all Californians, especially our children, whose health suffers disproportionately when our air is polluted. The future health of California's environment and economy depend on our taking action now."[1]

With these words before his election, Governor Arnold Schwarzenegger laid out a bold commitment to cleaning up air pollution in the state of California.

Citing the fact that children who live near freeways suffer significantly elevated asthma rates and learning disabilities, the then-gubernatorial candidate pledged to clean up California's dirty air, reducing statewide emissions by 50% from current levels by 2010.[2]

At a time when federal pollution controls are being weakened, Governor Schwarzenegger has envisioned an unambiguous role for California: as a state, we will buck the federal rollbacks and maintain our role as national leaders, pioneering clean air protections to protect all who live and work in the Golden State.

Now state regulators and agencies must chart the course towards clean air, developing and implementing the programs that will achieve the Governor's Healthy Air Goal.

The first step in establishing a blueprint is quantifying exactly how much air pollution can be avoided by policies already authorized or in development in the state of California. This document summarizes such efforts already underway or in development by California's Environmental Protection Agency and Air Resources Board to reduce two pollutants that are threatening health throughout much of the state—ozone and diesel particulate matter.

The next step is identifying additional programs to fulfill the promise of cutting health threats in our air in half over the next six years, a goal at once ambitious and urgent. Fortunately, the technological and public policy tools exist to achieve the long-term vision of a California where the air is safe for all of us to breathe—and to do it by the end of the decade.

For decades, air pollution has harmed the health of millions of Californians. But with strong leadership and a commitment to concrete air pollution reductions, we can achieve a safer and healthier future for California.

Air Pollution Is Harming California

How Air Pollution Affects Public Health in California

California has the highest levels of air pollution in the nation. In particular, high levels of smog, soot, and diesel particulate pollution continue to threaten public health, contributing to impaired lung function (even in healthy adults), respiratory diseases such asthma and bronchitis, and increased risk of cancer.

These health impacts, experienced by millions of Californians, have a ripple effect on friends, families, and coworkers; indeed, higher medical and insurance costs and lost productivity from missed school and work affect the state's economy and all who live and work in the state.

Asthma and Respiratory Illness

The California Air Resources Board estimates that nine in ten Californians breathe unhealthful air at least some of the time.[3] According to an analysis by the American Lung Association, more than 5.5 million children – and nearly 70% of all Californians – live in areas that fail health standards for ozone, a pollutant known to cause and exacerbate asthma and respiratory illness. Statewide, 560,000 children are estimated to have pediatric asthma.[4]

While asthma is the leading chronic illness in children and the number one cause of missed school days in the United States as a whole, California has a higher percentage of asthmatics than the national average (11.9% versus 10.1%), with 3.9 million adults and children statewide diagnosed with asthma.[5]

A ten-year children's health study conducted by the California Air Resources Board in conjunction with academics from the University of Southern California recently documented that physically-active children from communities with high ozone levels experienced significantly higher asthma rates than those from communities with less smog in the air, providing definitive proof that smog can, in some cases, cause asthma.[6]

The UCLA School of Public Health has estimated that asthma causes 10 million missed school days and 9 million lost workdays each year across the nation, which translates to lost productivity costing businesses and the government more than $10 billion annually.[7] **Figure 1** illustrates the pyramid of public health impacts of asthma and related respiratory illness.

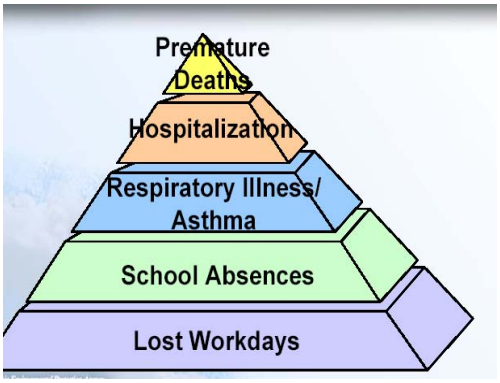


Figure 1: Pyramid of Smog Pollution Impacts[8]

Asthma attacks are just one endpoint in a pyramid of public health effects of air pollution ranging from lost workdays to hospitalization and premature death.

Cancer Risk From Breathing Air Pollution

Californians experience an elevated risk of cancer simply from breathing outdoor air with high levels of toxic contaminants.

Although there is a toxic stew of airborne contaminants ranging from acrolein to xylene in California's air, one class of pollutants is responsible for more than half of the elevated cancer risk in California—diesel particulates.

Cancer risk from diesel particulate pollution varies in different parts of the state, but Air Resources Board (ARB) studies have estimated that lifetime exposure to diesel particulates in the outdoor air at current levels will lead to 450 additional cancers per million residents—or 16,200 additional cases of cancer statewide.[9]

The risk is greater for Californians who are exposed to higher levels of diesel particulate pollution for longer durations. For example, a Californian living and working next to a freeway that experiences high volumes of truck traffic is susceptible to an elevated risk of getting cancer over his or her lifetime that is estimated to be anywhere from 40% to 350% higher than the statewide average.[10]

Cancer is not the only health impact resulting from exposure to diesel particulates. **Table 1** summarizes health impacts estimated to result from diesel particulates in the state each year. As one Air Resources Board analysis highlighted, the number of hospital admissions from diesel pollution is comparable to the total number of deaths from car accidents statewide, and the number of premature deaths exceeds the number of homicides experienced statewide in a year.

Table 1. Health Impacts of Diesel Particulates in California[11]
Annual health impacts
– 2,900 premature deaths
– 3,600 hospital admissions
– 240,000 asthma attacks/respiratory symptoms
– 600,000 lost days of work
By comparison
– 3,700 deaths from car accidents
– 2,000 homicides

Much of California Fails Federal Health Standards for Air Quality

California's Air Contains Unhealthy Levels of Smog

Nine of the ten counties with the highest smog levels nationwide are in California.[12] According to the American Lung Association's *State of the Air 2004*, in many areas of the state, including Fresno, Kern, San Bernardino, Tulare, Riverside, Los Angeles, and Merced, the air is unhealthy to breathe more than one out of every three days of the year.

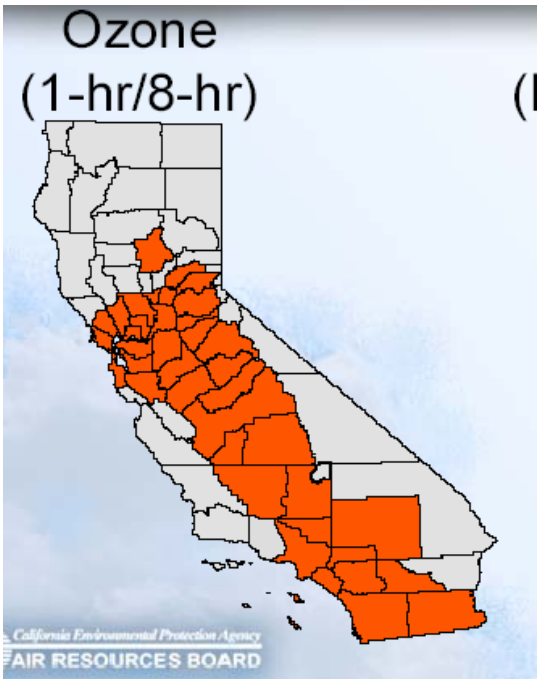
Table 2. Counties with the Worst Ozone Pollution

	2004 National Rank
SAN BERNARDINO, CA	**1**
FRESNO, CA	**2**
KERN, CA	**3**
RIVERSIDE, CA	**4**
TULARE, CA	**5**
LOS ANGELES, CA	**6**
HARRIS, TX	7
MERCED, CA	**8**
EL DORADO, CA	**9**
KINGS, CA	**10**

Why Is California's Air Quality So Poor?

As **Figure 2** indicates, health standards are violated throughout much of Central and Southern California. In much of the state, emissions of chemical pollutants from industrial, residential, and commercial activity couple with meteorological conditions to create the perfect conditions for the formation of ozone.

Figure 2: California counties violating ozone health standards[13]



Ground-level ozone, commonly known as smog, is formed when nitrogen oxides (NOx, emitted from power plants, automobiles and other sources) chemically combine with reactive organic gases (ROG, compounds emitted by mobile sources, solvents, and consumer products).[14]

Since this reaction occurs in the presence of sunlight, smog is of particular concern in areas and times of year when sunshine is most intense. In addition, ozone formation is a bigger problem in areas where the ozone does not quickly disperse.

Federal Air Quality Standards Established to Limit Public Health Threat

The federal Clean Air Act has identified a number of pollutants of particular concern due to their impact on human respiratory health, and established air quality standards for these pollutants. Air quality standards exist for ozone. Air quality standards also exist for particulate matter, commonly referred to as soot, and other pollutants not discussed in this report, such as carbon monoxide and sulfur dioxide.

Federal health standards for ozone, commonly known as smog, were originally based on a one-hour standard—if ozone levels averaged over a one-hour period exceeded 0.12 parts per billion, the standard was violated. This one-hour standard was recently replaced by a stronger standard—if ozone concentrations average greater than 0.08 parts per billion over an 8-hour period, the new standard is violated.

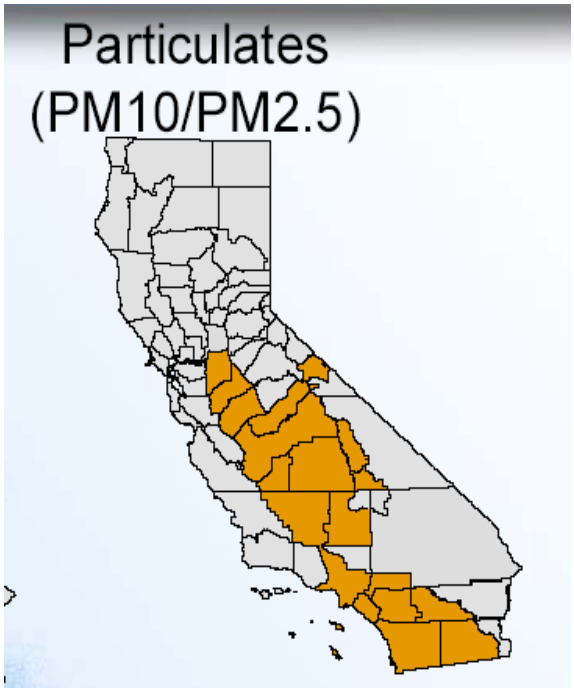
Dangerous Particulate Pollution Is Also of Concern

Significant parts of the state of California also fail federal health standards for airborne particulates—particles in the air that can bore deep into human lung tissue when breathed.

There are many types of particulate matter emitted by human activity: soot from smokestacks, dirt kicked up by vehicles on gravel or dirt roads, dust from bulldozing and mining, smoke from burning wood, and gasoline and diesel exhaust, to name a few.

Particulate matter from diesel exhaust is of particular concern since it is the single largest contributor to statewide cancer risk from outdoor air pollution.

Figure 3: California Counties Violating Soot Standards[15]



Driving State Cancer Risk from Air Pollution: Diesel Particulates

Diesel engines emit a complex mixture of air pollutants. The visible emissions in diesel exhaust are known as particulate matter. These include many carbon particles (also called soot) as well as other gases and water vapor that become visible as they cool.

In 1998, California identified diesel particulate matter (PM) as a toxic air contaminant based on its potential to cause cancer and other adverse health effects. The Air Resources Board has estimated that for every 14.11 tons of diesel PM pollution reduced, one life is saved.[16]

In 2000, manmade sources emitted 28,000 tons of diesel particulates statewide.[17]

In addition to PM, emissions from diesel-fueled engines include over 40 other cancer-causing substances. Overall, emissions from diesel engines are responsible for the majority (70%) of the potential airborne cancer risk in California—more than all other air toxics combined. **Table 3** shows the ten California counties with the highest diesel particulate emissions.

Table 3. Top Ten Counties for Diesel Particulate Matter Emissions, 2003.[18]

County	Air Basin	tons/year	Percent
Los Angeles	South Coast	4570	18%
San Diego	San Diego	1704	7%
Orange	South Coast	1678	7%
Fresno	San Joaquin Valley	1027	4%
Riverside	South Coast	999	4%
Santa Clara	San Francisco Bay Area	914	4%
Alameda	San Francisco Bay Area	910	4%
San Bernardino	South Coast	801	3%
San Francisco	San Francisco Bay Area	773	3%
Kern	San Joaquin Valley	764	3%

The State Has Taken Leadership on PM Standards

California has adopted more protective air quality standards than the federal government for soot pollution, with a 24-hour state standard for PM 10 that is three times stronger than the national one.[19]

These strong standards, paired with a 2003 law authorizing strong controls for PM emissions, should help drive aggressive agency rulemaking over the next year to adopt all available, feasible, and cost-effective measures for reducing this pollutant. This in turn will help prevent thousands of PM-related illnesses such as asthma and cardiovascular disease in California, and reduce cancer risk from breathing airborne toxic contamination by 2010.

The Healthy Air Goal: Cutting Current Emissions in Half

Smog Emissions in 2003

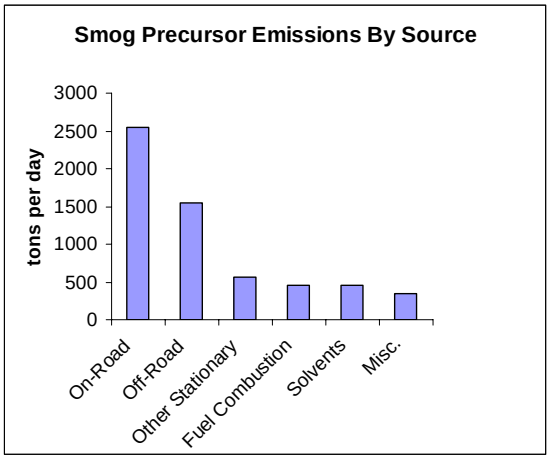
In California, manmade sources are responsible for nearly 6000 tons per day of emissions of NOx and ROG—annual emissions of 120 pounds for every resident of the state.[20] Of this, roughly 65% comes from sources under state or federal regulation.[21]

In 2003, 75% of California emissions of nitrogen oxides and nearly 50% of reactive organic gases came from mobile sources – cars, trucks, buses, and other forms of transportation that rely overwhelmingly on petroleum fuel. Much of the remaining emissions came from petroleum production and other fuel combustion.[22]

The largest emissions source unrelated to fuel combustion is toxic consumer products used for cleaning, painting, or coating, which were responsible for roughly one quarter of reactive organic gas emissions in 2003.

A look at the current sources of smog-forming emissions (**Figure 4**, showing NOx and ROG emissions combined) reveals that reducing this health threat will depend on addressing emissions from cars, trucks, buses, and other engines (mobile sources), and emissions from solvent evaporation, cleaning, and surface coatings.

Figure 4. Sources of Smog-Forming Emissions, 2003 (tons per day)[23]

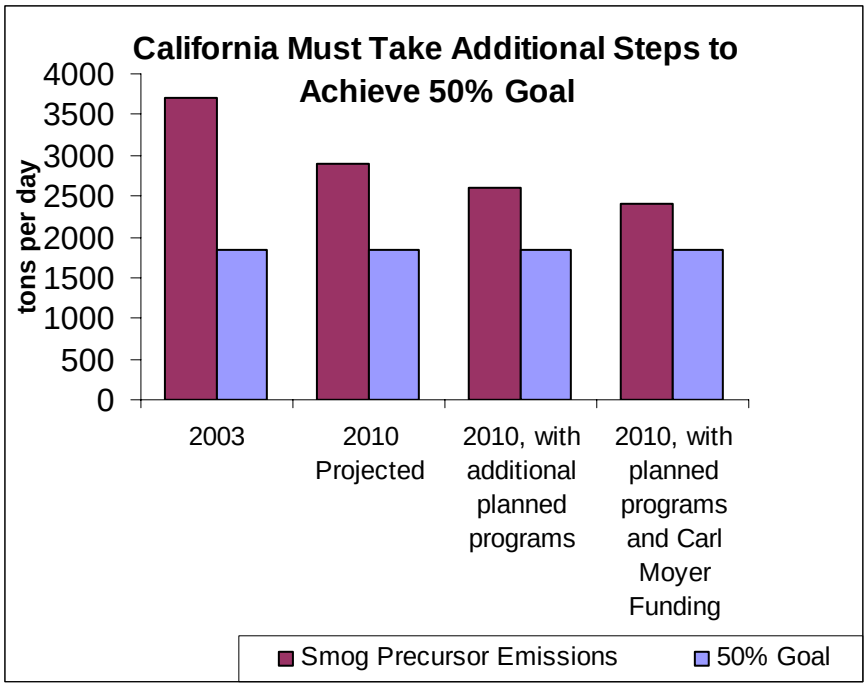


Sources under state and federal regulation were responsible for over 3,700 tpd of combined NOx and ROG emissions in 2003. Achieving the Healthy Air Goal for smog-forming emissions would require cutting these emissions by 1900 tpd by 2010.

Figure 5 shows how current, proposed, and incentive programs combined will not achieve the 50% goal by 2010. These scenarios will be discussed in the following sections of the report.

Figure 5. Projected Smog-Forming Emissions

(2010 emissions projection based on programs already on the books.)



Diesel Particulates

The major sources of diesel PM in California are the 1,250,000 diesel-fueled engines and vehicles that operate in the state. This includes the trucks and buses on our highways, large off-road equipment such as bulldozers and tractors, engines used in portable equipment such as cranes, refrigerating units on trucks, and stationary engines used to generate power or pump water. All together, these diesel engines release over 25,000 tons per year of particulate matter into California's air. About two-thirds of these emissions come from off-road equipment.[24]

Cutting Current Emissions in Half

Achieving the Healthy Air Goal for diesel particulate emissions will require cutting 38.4 tpd of diesel particulate emissions by 2010. Regulators estimate that based on programs in place by 2000, 14.5 tpd of emissions would be cut. Additional planned and proposed programs would need to achieve an additional 23.8 tpd in emissions reductions. **Figure 6** shows the anticipated reductions achievable under a number of scenarios discussed in detail later in this report.

Figure 6.

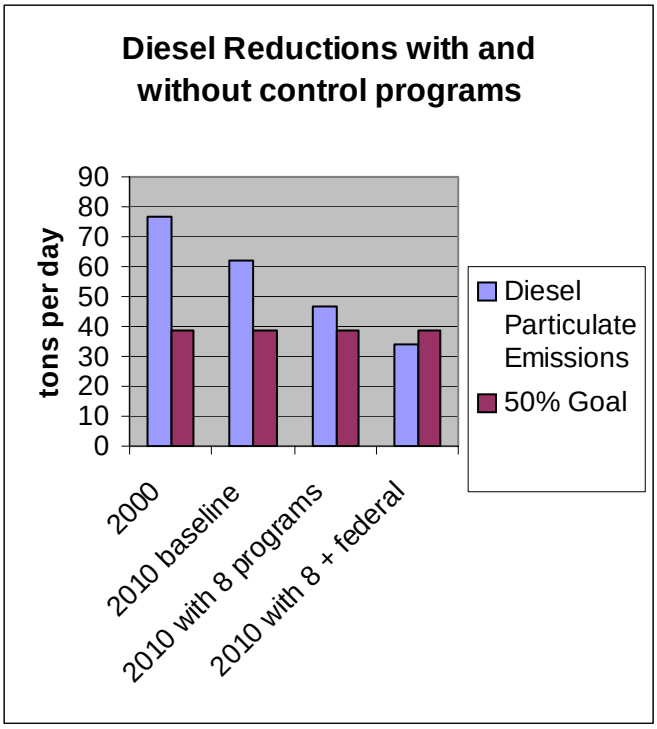


Table 4. Achieving Healthy Air Goal for Diesel Particulate Emissions

Diesel Particulate Emissions in 2010, Control Scenarios	
2010 Baseline[25]	62.2
Reductions from state programs[26]	-15.4
Potential reductions from federal programs[27]	-13

Four Steps to Achieving the Healthy Air Goal

Achieving the Healthy Air Goal of 50% pollution reductions for both smog and diesel particulate emissions will require a four-pronged attack:

1. Maintain and fully enforce strong standards and programs already adopted by law.
2. Move forward with additional planned pollution controls at the earliest possible date.
3. Identify additional programs to fill the gap in needed pollution reductions by 2010.
4. Leverage California's leadership to prevent federal rollbacks of Clean Air laws and regulations.

The following sections will look at the role of each of these approaches in further detail.

Step 1: Maintain Strong Programs That Have Already Been Adopted As Law

Smog

Statewide, we estimate that programs adopted as of 2003 will result in a reduction of over 800 tpd of smog precursor emissions, a 22% reduction from 2003 levels—in other words, these programs already in place to curb ozone-forming pollution should achieve nearly half (44%) of the Governor's goal.[28]

Of pollution sources under state authority, regulations have been adopted to address three main sources of smog-forming pollution:

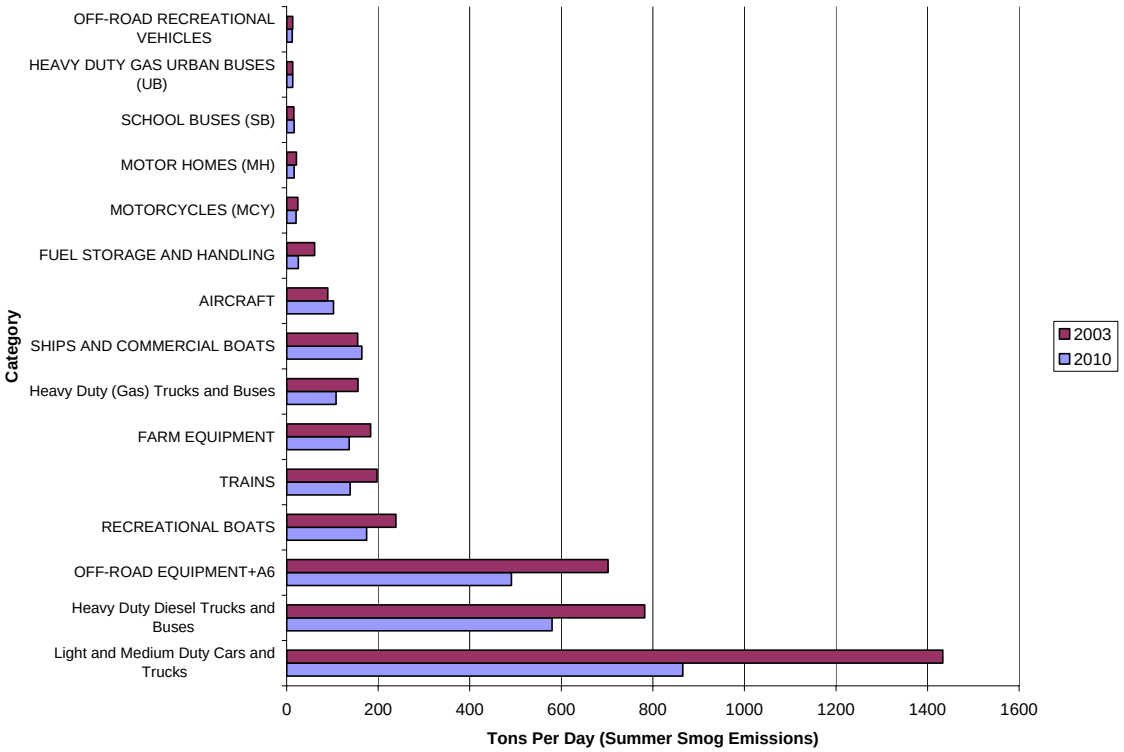
- On-Road Mobile: Cars, trucks, buses, and motorcycles;
- Offroad Engines: Boats, trains, and other large and small engines; and
- Consumer Products.

I. Cleaning Up On-Road Mobile Sources: Cars, Trucks, and Buses and Motorcycles

Figure 7 shows 2003 and projected 2010 emissions of smog-precursors by mobile sources. On-road mobile sources are the biggest source of air pollution in California. Cars, SUVs, trucks, and buses emitted 1,584 tons of NOx, 830 tons of ROG, and 49 tons of PM each day in 2003.[29]

Significant reductions can be anticipated in this sector due to a number of important programs—but the California Low Emission Vehicle II (LEV II) program leads the way.

Figure 7. Mobile Source Emissions, 2003 and 2010



LEV II/ZEV Leads the Way

Statewide, light-duty mobile sources covered by the LEV II and ZEV requirements emitted 727 tons of nitrogen oxides (NOx) per day and 691 tons of reactive organic gases (ROG) per day in 2003—the single largest source of smog-forming emissions in the state.[30] Due to the LEV II and ZEV programs, cars, SUVs, and light trucks will emit less NOx and ROG in 2010. They are projected to produce 382 tons of NOx per day and 410 tons of ROG per day in 2010, reducing total smog-forming emissions from this source by 44%.[31]

California established the Low Emission Vehicle program (LEV) in 1990. LEV included strict tailpipe standards and a requirement that a certain percentage of vehicles sold in the state be "zero-emission vehicles" (ZEV). The program was strengthened in 1998 with the adoption of LEV II standards. In addition to tightening standards for cars, the LEV II program will reduce emissions from SUVs and light trucks to the same level as emissions from cars.[32] The ZEV standards also have been modified since their adoption in 1990, the result of both California's efforts to build more flexibility into the program and legal action filed by automakers. Manufacturers now can satisfy some of the emissions reduction goals by selling a mix of pure ZEVs and "partial ZEVs"—including hybrid-electric and ultra-clean conventional gasoline-powered cars.[33]

The LEV and ZEV standards are important not only for the air pollution reductions they have achieved for California and will continue to achieve through 2010, but also for their

ability to jump-start advanced technology vehicle development and encourage adoption of those technologies in the mainstream auto market.

An example of the power of these programs to hasten technological change is the development of hybrid vehicles. California's adoption of the original ZEV requirements sparked public- and private-sector research efforts into the development of advanced batteries and electric-drive technologies. While the generation of full-function electric vehicles that resulted from that research—such as Honda's EV-Plus and General Motors' EV1—did not result in large quantity sales, the research effort drove advances in electric vehicle technology that facilitated the birth of the popular hybrid-electric systems that now power tens of thousands of vehicles worldwide.[34]

LEV II/ZEV is arguably the most important program in place in curbing smog over the near and long-term in California. The NOx and ROG emissions savings from the LEV II and ZEV programs occur despite the fact that there will be 3.3 million more cars on the road in California in 2010 than in 2003, and that Californians will drive an additional 108 million miles per year, a 14% increase over 2003.[35]

Table 5. Emissions from mobile sources (tons/day)

	NOx	ROG
Emissions in 2003	727	691
Emissions in 2010 with LEV II and ZEV standards	382	410
Savings	**345**	**281**
Percentage reduction from 2003 levels	47%	41%

A Note on Hydrogen Fuel Cell Vehicles and the 2010 Healthy Air Goals

Governor Arnold Schwarzenegger has announced an ambitious plan to construct more than 100 hydrogen fueling stations along California highways—a development that he hopes will lead to the rapid deployment of thousands of hydrogen fuel-cell vehicles—vehicles with no tailpipe emissions.[36] For several reasons, however, state efforts to encourage the use of hydrogen fuel-cell vehicles are unlikely to make a significant impact on air pollution by 2010.

First, it is generally thought that natural gas or the current electricity grid—not zero-emission renewable sources of energy—will be used to generate hydrogen in the opening stages of a transition to a hydrogen economy. These sources of hydrogen are not emission-free. Natural gas power plant emissions alone are responsible for roughly 140 tons per day of NOx emissions each year in California.[37]

Hydrogen from either natural gas or electricity *would* virtually eliminate vehicle-related emissions of volatile organic compounds (a close chemical relative of ROG), reducing them by more than 90%. Hydrogen from renewable sources of energy would be virtually emission free – but given current technological constraints, would be vastly more expensive than either natural gas or electricity-powered fuel cells.

Should California achieve Gov. Schwarzenegger's vision of 500,000 fuel-cell vehicles on the road by 2010, the state would likely experience NOx emission reductions of over 500 tons per year and VOC reductions of about 1000 tons per year, provided that the hydrogen is generated at filling stations from natural gas—this translates to approximately 4 tons per day.[38]

However, it is extremely unlikely that this target will be met. Today in California, there are fewer than 100 fuel-cell vehicles on the state's highways in demonstration projects. To achieve the goal of 500,000 vehicles by 2010, nearly 100,000 fuel-cell vehicles would need to be sold in the state each year until the end of the decade. For reference, fewer than 50,000 new hybrid-electric vehicles—which have been available in American showrooms for five years—were registered *nationwide* in 2003. Moreover, California's zero-emission vehicle program will likely require the sale of less than 3,000 fuel-cell vehicles *total* by the end of 2010.[39]

In addition, even the most optimistic observers, including General Motors—believe that hydrogen fuel-cell vehicles will not become generally available until around 2010.[40] The U.S. Department of Energy believes that even with a successful development effort, the information needed to make a decision on the commercialization of fuel cells in transportation and other applications may not be available until 2015, with fuel cell vehicles "hitting the showrooms" in 2020.[41] Other industry observers believe that it will be 20 to 30 years, if then, before there is widespread commercialization of fuel cell vehicles.[42]

In summary, there remain serious technological and cost hurdles in the way of a transition to a hydrogen-based transportation system. The state of California is working to remove some of those hurdles and reasonable efforts toward that goal should continue. It is unrealistic, however, to believe that hydrogen fuel cell vehicles will make a significant contribution to achieving the governor's air pollution reduction pledge.

Cleaner Heavy-Duty Trucks and Buses

Buses

Statewide, heavy-duty diesel trucks and buses were the second largest source of smog-forming emissions in 2003 among mobile sources, responsible for 780 tons per day of smog-forming emissions.[43] This is projected to decline by 25% to 580 tpd based on programs that have already been adopted as law, most notably, federal standards for heavy duty diesel trucks and low sulfur diesel fuel.

The U.S. Environmental Protection Agency (EPA) issued rules in January 2001 that started taking effect this year establishing new diesel engine standards for heavy-duty vehicles (trucks and buses over 8,500 pounds.) Additional diesel standards and test procedures in this final rule will begin in 2007. Heavy-duty gasoline engines will be required to meet new, more stringent standards starting no later than the 2005 model year. The new standards require gasoline trucks to be 78% cleaner and diesel trucks to be more than 40% cleaner than today's models. The second phase of the program, expected to go into effect in 2007, will require cleaner diesel fuels and even cleaner engines, and will reduce air pollution from trucks and buses by another 90%.[44]

The California Air Resources Board has adopted amendments to ensure that the state requirements for 2007 and subsequent model years are identical to those adopted by the U.S. EPA in January 2001. The Board expects that the adopted, more stringent, emission standards will reduce statewide smog-forming emissions from California and out-of-state registered medium-duty and heavy-duty vehicles by 51 tons per day and PM emissions by 3 tons per day in 2010, statewide.

Motorcycle Standards

Until recently, emission standards for motorcycles were weaker than for cars and trucks. That changed in 1998 when CARB adopted new pollution standards for motorcycles, beginning in model year 2004. Further emissions reductions will be required for model year 2008 motorcycles.[45] The changes will reduce ROG emissions by 0.85 tons per day and NOx emissions by 0.48 tons per day by 2010.[46]

Enforcing the Standards: Inspection and Maintenance

The Inspection and Maintenance program, better known as Smog Check, requires that vehicles undergo an emissions test before being granted a renewal registration, re-registered with a new owner, or newly registered in the state. In most of California, vehicles must be tested every two years at a certified smog-check station.[47] Automobiles that fail the test must be repaired and retested.

The inspection and maintenance program is expected to reduce emissions of NOx by 66 tons per day in 2010 compared to 2002.[48]

Motorists who need financial help can receive up to $500 to repair their vehicles. The state also once offered $1,000 to motorists to voluntarily retire cars that failed smog tests, but that program was cancelled due to budget constraints.[49]

Not all vehicles must undergo emissions testing. Diesel vehicles, two-cycle engines, and motorcycles are exempt. Provided the vehicle is not sold or being registered in California for the first time, vehicles from the four most recent model years are also exempt. Older vehicles—those 30 or more model-years old—do not need to be tested either.[50]

In addition, California has adopted standards that strengthen federal testing rules (known as the Supplemental Federal Test Procedure) that are anticipated to reduce smog-forming emissions during fast driving, rapid acceleration, and air conditioner use. The rules will begin to reduce emissions between 2001 and 2005.[51]

II. Offroad Engines

Offroad engines comprise a significant fraction of the current smog-forming emissions inventory, with emissions from this source comparable to the level of smog-forming emissions from heavy-duty trucks and buses.

Marine Engines

Statewide by 2010, standards for outboard engines and personal watercraft enacted in 2001 will achieve 110 tpd reductions in smog-forming emissions.[52] Additional standards for boats with inboard and sterndrive engines will reduce smog-forming emissions by another 10 tpd.[53]

Recreational marine engines are significant sources of NOx and ROG emissions, particularly on summer weekends when their use is highest.[54] Until recently, emissions from most marine pleasure craft engines were unregulated and the engines had no emission-control devices. After the federal government adopted emissions standards, California accelerated the implementation of those rules and established tighter standards that will become effective in 2004 and 2008.[55]

Large Off-road Gasoline Vehicles

California has adopted stricter emissions standards for large off-road gas vehicles that have been phased in since 2001.[56] Expected emissions savings by 2010 from these standards are 55 tpd.[57]

Large off-road gasoline and liquefied petroleum gas (propane) engines are often used in forklifts, portable generators, and farm and construction equipment.

Small Offroad Engines

New standards for small offroad engines scheduled for implementation over a two-year period beginning in 2007 are expected to reduce ROG emissions by roughly 18 tpd by 2010.[58]

III. Consumer Products

Consumer products, such as detergents, cosmetics, garden products, and furniture coatings, are a major source of ROG emissions statewide—second only to pollution from automobiles and other mobile sources.

Pollution from products used by a single consumer may seem minor, but when such activity is multiplied by the activities of millions of Californians, the resulting emissions are significant. In the greater Los Angeles area, for example, such products release three times more ROG emissions than all area factories.[59]

From 1989 to 2000, California adopted emission standards for 82 products.[60] Regulations adopted in 1997 and 2000 will not be fully effective until 2005. At that time, they will reduce ROG emissions by 36 tons per day.[61]

What About Power Plants?

Stationary sources, including power plants, were estimated to emit roughly 500 tons per day of NOx emissions in 2002. Of these emissions, a large portion (more than 80%) is attributable to fuel combustion. Based on programs currently in place, emissions from fuel combustion are projected to increase slightly between now and 2010, from 410 tpd in 2003 to 425 tpd in 2010. When compared to the emissions reductions projected from on-road mobile sources, it is clear that programs in this sector are not contributing their proper share of reductions in light of the 50% clean-up goal.

Emissions from this sector could be reduced through a combination of stronger controls and stricter permitting. However, promoting renewable energy sources and efficiency measures in place of conventional fossil-fuel combustion can also play a role in reducing NOx emissions.

Replacing 10,000 MW of natural gas power generation and 500 MW of in-state coal-fueled combustion by developing the state's considerable renewable energy resources and reducing energy demand through efficiency measures could displace 75 tpd of NOx emissions, reducing 2010 emissions from fuel combustion by more than 20%.

Displacing fossil fuel power generation with renewable energy would not only result in public health benefits by helping clean up smog—it would be a critical step in tackling global warming emissions.

The most important state program already in place to curb diesel particulate emissions is the Air Resource Board's Diesel Risk Reduction Plan, an ambitious blueprint for reducing diesel particulate emissions. The Diesel Risk Reduction Plan (Diesel RRP), first published in October 2000, aims to reduce the public health threat of diesel particulates by 75%. To do so, the plan identified a number of control strategies, including:

- Reduce emissions from new engines.
- Clean up existing engines by up to 85% through retrofitting (largely with diesel particulate filters, or DPFs) wherever technically feasible and cost-effective.
- Ensure in-use emissions performance (inspection and maintenance).
- Provide low-sulfur diesel fuel (15 parts per million) to enhance effectiveness of filters.[62]

If the state's entire plan were implemented successfully and on schedule, diesel particulate emissions would drop from 28,000 tons per year to 12,344 tons per year, a decline greater than the 50% target.

However, the state has not been as successful as originally hoped in controlling emissions from existing engines—vehicles currently in use. Particulate filters have not been as broadly applicable as anticipated. This means that the state is unlikely to achieve all the reductions included in the Diesel RRP.

The Diesel RRP projected that even without implementation of the plan, diesel particulate emissions would drop from 76.7 tons per day in 2000 to 62.2 tons per day in 2010, a 19% reduction.

The Diesel RRP highlighted nine state policies and two federal policies that, along with low sulfur diesel fuel, could achieve significant diesel particulate pollution reductions. (See **Table 6.**)

We calculate that the state policies identified by the plan could achieve reductions of 15.4 tons per day by 2010, if enacted on the proposed timelines.[63] Enacting these recommendations would therefore bring 2010 emissions down to 46.8 tons per day, a nearly 40% reduction from 2000 levels.

To achieve and exceed the Healthy Air Goal would not be possible based on state efforts alone. Rather, it would rely on federal efforts, such as controls for commercial marine vessels and locomotives. (See **Figure 8.**) While the state should advocate for federal rulemakings to achieve cleaner ships and trains, ideally the state would identify additional controls within its authority to fill the gap between current efforts and the 50% goal.

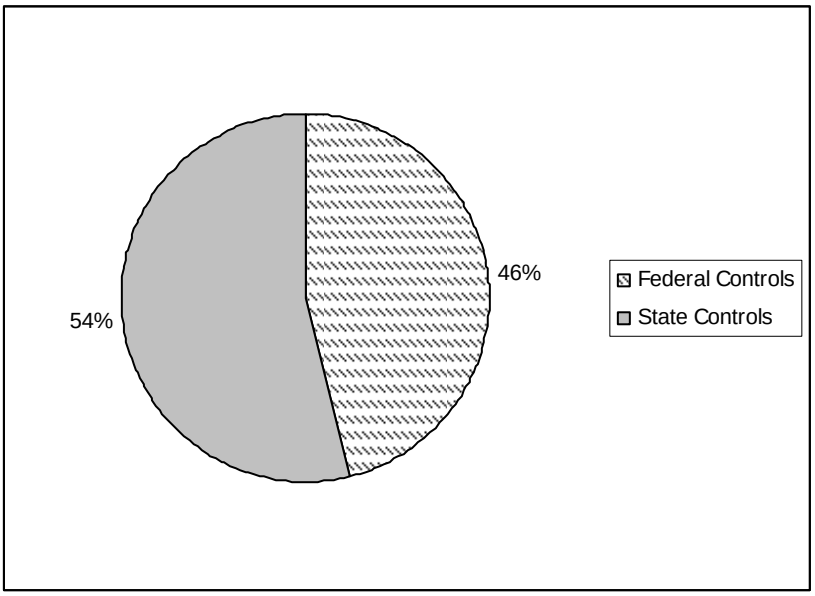
Under the Diesel Risk Reduction Plan, a number of important programs have already been adopted, including:

- Low Sulfur Diesel Fuel (July 2003)
- Lower Emission School Bus Program (December 2000)
- School Bus Idling Rules (December 2002)
- Solid Waste Collection Vehicles standards (September 2003)
- Retrofit verification Program (May 2002)

Table 6. Diesel Risk Reduction Plan Measures

	Measures	Proposed implementation date
ONROAD	Lower emission standards for new HDV engines	2007
ONROAD	Control of emissions from existing engines (retrofit)	2002-2008
OFFROAD	Lower emission standards for new engines	2006-2008
OFFROAD	PM standards for new diesel pleasure craft engines	2005
FEDERAL	Locomotive retrofit	
FEDERAL	Commercial marine vessels retrofit	
STATIONARY	New engine standards	2002
STATIONARY	Prime engine retrofit	2003
STATIONARY	Emergency engine retrofit	2003
PORTABLE	Off-road portable engine retrofit	2003-2005
AG ENGINE	Agricultural engine retrofit	2003-2005

Figure 8. California's Diesel Risk Reduction Plan Relies Heavily on Possible Federal Controls[64]



The Lynchpin for PM Reductions: Low-sulfur Diesel Fuel

Through 2010, low-sulfur fuel rules are expected to reduce statewide emissions from on-road diesel engines by 38 tons of NOx per day and 3.1 tons of PM10 per day.[65]
State regulations currently require that diesel fuel have a sulfur content less than 500 ppmw (parts per million by weight).[66]

A limit of 15 ppm will go into effect in 2006 for both onroad and offroad engines, and is estimated to reduce PM10 emissions by 4%.[67] The revised sulfur limit is essential for the success of filters and other control technologies planned as part of CARB's diesel risk reduction plan.

Other Mobile Source Controls

Lower Emission School Bus Program

In California's March 2002 election, voters passed Proposition 40, a bond to provide $50 million to the Air Resources Board for grants to air districts to purchase very low- or zero-emission vehicles, emission-reducing retrofits of vehicles, and emission-reducing add-on equipment, as well as to develop and demonstrate low-emission technologies.

While school buses are not the largest source category of mobile source emissions, they are of special concern due to the long-term health risks posed to children of exposure to diesel particulate emissions. Researchers from UCLA and UC Riverside studied exposures of children on actual Los Angeles area bus routes, finding that children who commuted by conventional diesel school bus (assuming commutes by bus for 13 years) were estimated to have a heightened lifetime cancer risk due to diesel particulate matter by approximately 4%.[68]

The Lower-Emission School Bus Program, state-funded at $37.5 million in its first year (2000-2001) helped purchase 238 alternative fueled buses and 145 low-sulfur diesel buses while retrofitting 1500 buses with filters that reduce particulate emissions by 85%. However, funding for the program declined to $12 million in 2001-2002 and $4.9 million in 2002-2003. All of this funding was earmarked for purchase of clean school buses, not retrofits.

At current funding levels, 45 school buses can be replaced per year. Based on the funding allocation of $4.6 million for the 2003-2004 fiscal year, the California Air Resources Board estimates that the Lower-Emission School Bus Program will reduce NOx emissions by approximately 12 tons and PM emissions by approximately 8 tons over the entire period from 2005 through 2020.[69]

Cleaner Buses: Transit Bus Standards

The Air Resources Board has tightened standards for emissions from transit and urban bus fleets. The new regulations will be phased in gradually, allowing transit agencies to buy cleaner diesel buses or zero-emission buses, burn cleaner diesel fuel, and retrofit

older buses to capture PM emissions. The rules are projected to reduce PM emissions by 180 pounds per day by 2010.[70]

Solid Waste Collection Vehicles

This measure will reduce diesel particulate matter emissions by 0.28 to 0.38 tons per day (tpd) of particulate matter (PM) in 2010.[71]

Step 2: Move forward with additional planned pollution controls at the earliest possible date.

Savings from Planned Programs: Smog

In the near-term, the state has identified a number of measures that could result in additional smog-forming pollution reductions. Although these measures have not been adopted by regulation or incorporated into emissions inventory projections for 2010, the state has included them in its plans to the federal government for how they will achieve air quality standards—in doing so, making a federally enforceable commitment to adopt the proposed measures.

Cutting health-threatening pollution in half by 2010 will require these near-term measures, and more. Using state planning inventories and program estimates for the South Coast Air Quality Management District, we estimate that an additional 6% of current emissions of smog-forming chemicals can be reduced statewide with near-term measures the state has already identified—equivalent to 12% of the Governor's goal.[72]

This still leaves a gap of 22% of current emissions that must be reduced to achieve the Health Action Plan goal: cutting smog-forming emissions in half by 2010.

Additional controls for cars, SUVs, and trucks are expected to achieve half of total reductions from planned near-term measures, and consumer product regulations could achieve an additional 15%.

These programs vary in how much they would clean up the pollution source—for example, measures to clean up large spark-ignited off-road engines could reduce 2010 emission levels from these sources by as much as 40% below projections without these controls.

A Closer Look: Consumer Product Rules

The state has made a federally enforceable commitment to reducing an additional 25-40 tpd of ROG emissions from consumer products. These reductions are slated to be phased in via three separate rulemakings in 2004, 2006, and 2008.

Additional standards for consumer products including body, hair, and nail care products could reduce ROG emissions by 20 to 35 tons per day statewide in 2010.[73] These standards, slated to go into effect in 2008, would be adopted into state law between 2006 and 2008. Standards could apply to products whose use has grown significantly in recent years, or could limit the reactivity of products.[74]

Measures Currently In Development

A number of important air quality regulations are currently in development by the Air Resources Board but not yet finalized. These include requiring software upgrades for emissions control systems and idling rules.

Replace/Upgrade Emission Control Systems

This control measure could reduce 30-40 tpd NOx statewide by 2005, at a cost of under $100 per ton NOx reduced, making it one of the most cost-effective pollution controls available.[75]

Vehicles are equipped with emission sensors and control devices that deteriorate with age. More sophisticated sensors could detect declines in the performance of emission-control components and thus flag rising emissions.

The California Air Resources Board is investigating the value of requiring replacement of these components in older vehicles to ensure continued emissions control. If mandatory replacement seems feasible and effective, the state could achieve further NOx and ROG emissions reductions. In the South Coast alone, emissions of ROG could be reduced by as much as 19 tons per day and NOx by 18 tons per day in 2010.[76]

CARB staff has proposed rules requiring owners and operators of trucks, school buses, and motor homes with 1993-1998 model year heavy-duty diesel engines to upgrade the software in the electronic control module (ECM) of these engines. Software upgrades have already been developed by the engine manufacturers and are available now for most 1993-1998 model year engines used in 1993-1999 model year vehicles.

In California, it is estimated that faulty computer chips are allowing as much as 49 additional tons of nitrogen oxides to enter the atmosphere every day. However, the state Air Resources Board recently negotiated an agreement with engine manufacturers, withdrawing a proposal to make software upgrades mandatory, and replacing it with a voluntary program.[77]

Idling Rules

Proposed idling reduction requirements could reduce smog-forming emissions by 6 to 8 tpd by 2010.[78] In California, emissions generated by heavy-duty diesel vehicles while idling pose a significant air quality problem. Truck drivers idle their engines at truck stops, warehouse/distribution centers and port terminals where loading and unloading freight require long waiting periods. The high density of trucks idling together at such locations for extended periods can produce highly localized and concentrated emissions. Truck idling also consumes fuel and increases engine maintenance costs.

Savings from Planned Programs: Diesel Particulates

Current programs in development to curb diesel particulate emissions include stronger standards for spark-ignition offroad engines and refrigeration units. New offroad engine standards are particularly important, since these engines are currently responsible for 75% of diesel particulate emissions in the state, and today's emissions standards are four times weaker for offroad engines than onroad engines.[79]

Portable Engine Standards

Proposed rules for new diesel-fueled portable engines could reduce daily emissions from 4 tons to 2 tons, a 50% improvement by 2010.[80]

Refrigeration Units

Regulations are currently being finalized to limit diesel particulate emissions from transport refrigeration units—refrigerators powered by diesel engines used in transport of produce and other goods by truck vans, shipping containers, and rail cars.

The new rules could eliminate up to 0.6 tpd of diesel particulate emissions—equivalent to more than 400,000 pounds annually. Regulators estimate that there are nearly 50,000 refrigeration units in operation statewide, many of which are concentrated at distribution centers, ports, truck stops, and other facilities where they result in combined emissions that can pose a significant health risk to those who live and work nearby.[81]

Step 3: Adopt Additional Measures to Fill the Gap

Regulators currently refer to a "black box"—the emissions reductions still needed to meet federal air quality standards for which no control program has yet been identified. Incentive programs described below can play an important role in addressing "black box" emissions for smog-forming pollutants, and in achieving the goals of the Diesel Risk Reduction Plan. Depending on funding, incentives can help achieve 10%--or more—of the governor's goal, helping reduce hundreds of tons of smog precursor emissions daily.

Incentives

In conjunction with the strongest possible emission standards for new engines, financial incentives are a cost-effective way to help accelerate retirement or retrofitting of the oldest, dirtiest engines in use today.

The Air Resources Board has considered the potential emission benefits of incentives for clear trucks and buses, off-road vehicles and equipment, and small marine and RV engines. An analysis of these studies shows that $350 million in incentives annually for each of the next 5 years could make a significant dent in statewide emissions from both onroad and offroad mobile sources, achieving half of the remaining NOx emissions reductions needed to "fill the gap" to achieve the Healthy Air goal.

Cleaning Up Smog-Forming Emissions With Incentives: Carl Moyer Program

The Carl Moyer Program (CMP) cost-effectively reduced nitrogen oxide and diesel particulate emissions by replacing or retrofitting old engines from 1998 through 2004.

The program, currently unfunded, provided incentives in the form of grants to defray the costs of purchasing cleaner engines and equipment.[82] The California Air Resources Board has estimated that in the first four years of the Moyer Program (1998-2002), 14 tons of nitrogen oxides were reduced per day at a cost of $3000 per ton.

The types of projects funded by CMP fall into several categories:

- **On-road heavy-duty vehicles** (gross vehicle weight of more than 14,000 lbs) received 45% of CMP funding during the program's first four years.[83] The buses, trucks, and other vehicles in this category are responsible for nearly 40% of the NOx and PM emissions from on-road vehicles in California, even though they comprise only about 1% of all on-road vehicles. Collectively, on-road mobile sources are responsible for about half of total statewide NOx emissions.[84]
- **Stationary agricultural irrigation pumps** received 25% of funding during CMP's first four years.[85]
- **Marine vessels** eligible for CMP funding include commercial harbor craft as well as ocean-going vessels.[86] These vessels received 19% of funding during CMP's first four years.[87]

- **Off-road equipment** with engines over 50 horsepower (e.g. agricultural tractors, backhoes, and excavators) received 8% of funding during CMP's first four years.[88]
- **Forklifts** received 2% of funding during CMP's first four years.[89]
- **Locomotives** received 1% of funding during CMP's first four years.[90]

The Moyer Program Advisory Board (MPAB), created by the Legislature to review the program in 2000, recommended funding of at least $100 million per year through 2010.[91] Actual funding has fallen far short of that level—totaling nearly $100 million over the first three years and $54 million over the following three years, but currently unfunded. (See **Table 7.**)

An analysis by the South Coast Air Quality Management District compiled detailed data from historical usage of Carl Moyer Program funds and extrapolated the results to the future inventory of vehicles that might be eligible for such incentives. This analysis found that $3.5 billion in incentives in the South Coast alone could be used to cost-effectively fund retrofits—since South Coast has less than 50% of the statewide mobile emissions inventory, the statewide potential could be double that amount—justifying the dedication of $1 billion in funding annually for seven years.

Table 7. Funding for the Carl Moyer Program

Fiscal Year	Funding
1998-1999	$25 million[92]
1999-2000	$23 million[93]
2000-2001	$50 million[94]
2001-2002	$16 million[95]
2002-2003	$19.68 million[96]
2003-2004	$18 million[97]

Cost-effectiveness and future funding

With $300 million per year over the next five years, CMP could effect reductions in NOx emissions of about 200 tons per day.

Although CMP originally required that a given project have a cost-effectiveness of $13,600 per ton of reduced NOx emissions, average reductions have been achieved for approximately $3,000 per ton.[98] This compares favorably to other air pollution control programs.[99] However, future cost-effectiveness is expected to fall (i.e. it will cost more to achieve a given reduction in emissions) due to inflation and increasing cost of potential projects.

The California Air Pollution Control Officer's Association (CAPCOA) estimates that average cost-effectiveness over the next five years (2005-2009) could range between $3,692/ton and $4,652/ton.[100] Based on this, we estimate that $300 million could achieve 200 tpd in smog precursor emissions reductions, 12% of the governor's goal[101].

Diesel Particulate Matter Reductions Through Incentives for Retrofits

CARB's Diesel Risk Reduction Plan estimated that 1,700 to 3,500 tons of diesel particulates could be reduced per year through incentive programs, requiring $260 million to $525 million in total funding.[102] An analysis of PM emissions reduced by Carl Moyer Incentives indicates that this should be achievable.

Carl Moyer for Diesel PM Reductions

While originally developed to achieve NOx emission reductions, several air quality districts added requirements that CMP-funded projects also reduce PM emissions. Another analysis found an average of 212 tons per year (0.58 tpd) of reductions in PM emissions over the first three years of the program.[103]

Extrapolating from early PM reductions achieved by the Carl Moyer program, if future funding of $300 million annually is targeted for both NOx and PM reductions, 10.3 tpd of diesel particulates could be controlled.[104]

Additional Funding For the Lower Emission School Bus Program

Additional resources are necessary to replace or retrofit old, dirty school buses. It would take a minimum funding level of $177 million over the next five years to retrofit an additional 2,400 of the pre-1987 school buses still on the road today and replace 1,400 pre-1977 school buses—requiring Low Emission School Bus Funding of $35.5 million annually for the next 5 years. Most recently, (FY02-03) only $4.92 million was available for this purpose.

Cost of Retrofits

As of 2003, about 540 old school buses have been replaced with safer, low emission models, and 3,000 diesel buses had been retrofitted to reduce diesel emissions. An estimated 3,600 pre-1987 diesel school buses remain.[105] Considering that it cost $16.5 million to retrofit 3,000 buses during the first few years of the program, we estimate it would cost $19.8 million to retrofit the remaining 3,600 (assuming inflation is counteracted by progressively lower costs for the retrofit technology).[106]

Costs of replacements

Just under $50 million funded the replacement of 440 dirty diesel buses.[107] From this, we extrapolate that replacing approximately 1,400 remaining pre-1977 school buses would cost $157.5 million.

While it is beyond the scope of this report to identify emissions reductions achievable by additional programs in detail, it is within the clear purview and responsibility of state regulators to do so.

In considering other programs, it is worth noting that based on the current projected emissions inventory for smog-forming pollution in 2010, on-road mobile sources are still projected to be responsible for 35% of all emissions.[108] Continued growth in vehicle miles traveled is projected to mitigate the reductions achieved by tighter emissions standards for cars, trucks, and buses.

In addition to maintaining the strongest possible standards for new cars and trucks, the state should consider strategies to accelerate the retirement of the dirtiest vehicles on the road, and strategies to neutralize projected growth in vehicle miles traveled.

Limiting VMT Growth

The state should consider programs that will effect reductions in VMT growth—the number of vehicle miles traveled on California roads, a number that is projected to continue increasing steadily over the next decade.

On-road VMT is projected to increase by 1.65% per year from now through 2010, resulting in nearly 50 billion more vehicle miles on California's roads in 2010 than in 2003, and outpacing population growth. (See **Figure 9.**)

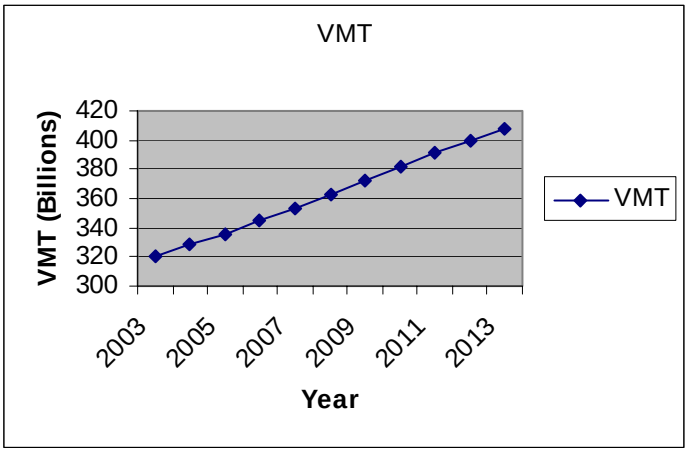


Figure 9. Projected Growth In State Vehicle Miles Traveled[109]

In the midterm, providing better public transit options and changing land-use practices and zoning can have a big impact on VMT. The impact on vehicle-miles traveled of both transit improvements and growth management policies has been well documented. Studies have shown that doubling the residential density of a given neighborhood reduces per-capita VMT by approximately 20 to 38%. Increasing the density of transit service has also been shown to reduce VMT.[110]

A more immediate impact on VMT can be expected with market-pricing mechanisms. Two programs suggested for consideration in achieving additional smog emissions reductions from the onroad sector include a VMT fee and congestion pricing.

Both the VMT fee and congestion pricing measures could potentially raise significant revenue for the state, more than enough to pay for the incentives discussed in the previous section. Governor Schwarzenegger specifically committed to considering congestion pricing in his environmental action plan.[111]

VMT Fee

Consultants hired by the California Air Resources Board in 1998 estimated that a VMT fee of 2¢ per mile (an average of $250 per year) could reduce emissions by about 4%, an emission fee ranging from $40 to $400 per year based on miles driven and average emission rates could reduce emissions by 4-6%, and a fee ranging from $10 to $1,000 per year based on actual emissions and miles driven could reduce VMT by 2% and emissions by 15-20%.[112] While these numbers may need to be adjusted based on stronger emissions standards implemented since 1998, they suggest that if the state established an emission fee of $50 to $500 annually based on actual emissions and VMT, it could result in a 5% emissions reduction, equivalent to 84 tpd of smog-forming pollution.[113]

Tolls, VMT fees, or fuel fees based on actual emissions have a secondary benefit: they may influence consumers' decisions in purchasing vehicles, toward cleaner cars.

Congestion Pricing

Implementing congestion pricing on major highways (in which commuters traveling during congested periods pay a toll) can reduce rush-hour traffic and promote alternatives, leading to significant air pollution emissions reductions.

In February 2003, the city of London implemented a congestion pricing system in which motorists driving in Central London between 7 am and 6:30 pm are charged a 5 pound fee. Since this system was established, congestion delays have declined by 30%, average traffic speed increased by 37%, bus ridership increased by 14%, and estimated revenues greater than 100 million pounds have been generated—enough to cover the operating costs as well as mass transit investments.[114]

The Los Angeles County Metropolitan Transit Agency and San Bernardino are studying the feasibility of a congestion mitigation fee, mirroring similar fees already in place in Orange County and Riverside County.[115]

California Air Resources Board researchers estimated in 1998 that charging 8¢ to 19¢ per mile could reduce congestion by 5-10%, VMT by 1.5-3%, and emissions by double that amount—3-6%—since additional benefits would be achieved by reducing stop-and-go traffic.[116] Drivers who pay to travel on routes with congestion management pricing

during peak hours save time, since other drivers switch to off-peak hours or less congested roadways or public transit to save money. Researchers at the University of Delaware similarly estimated that congestion pricing could reduce highway emissions of smog-forming pollution by 5 to 15%.[117]

An Air Resources Board study from 1995 estimated that congestion pricing averaging from $0.06 to $0.19 per mile could reduce VMT, travel times, and air pollution in four of California's major metropolitan areas, reducing NOx emissions by 1.7 to 3.6%, and ROG emissions by 3.7% to 8.1%, while generating $7.3 billion in revenue in the South Coast alone.

To address potential socioeconomic impacts of such a fee while still improving air quality and decreasing congestion, such revenue should be targeted to fund public transit improvements that ensure efficient, affordable access for more people.

Table 8.

Analysis Results for Congestion Pricing (2010)*[118]

Region	Bay Area	Sacramento	San Diego	South Coast
Average Price (per mile)	$0.13	$0.06	$0.09	$0.19
VMT(weekly)	(2.8%)	(1.5%)	(1.7%)	(3.3%)
Trips (weekday)	(2.7%)	(1.4%)	(1.6%)	(3.1%)
Time (weekday)	(8.2%)	(4.8%)	(5.4%)	(9.7%)
Fuel/CO2 (daily gallons)	(8.3%)	(4.8%)	(5.4%)	(9.6%)
ROG (daily)	(6.9%)	(3.7%)	(4.2%)	(8.1%)
CO (daily)	(6.9%)	(3.9%)	(4.3%)	(7.9%)
NOx (daily)	(3.2%)	(1.7%)	(2.0%)	(3.6%)
Annual Revenue (millions of dollars)	2,274	443	896	7,343

Investing in Public Transit

Giving people more transportation choices can dramatically lower automobile use, reducing air pollution and the accompanying effects on public health. In fact, according to a study done by the Centers for Disease Control and Prevention in Atlanta, providing

more transportation choices during the 1996 Olympics reduced traffic by 22%, air pollution by 28% and asthma attacks by up to 42%.[119]

Developing a plan to increase public transportation service and choice while decreasing automobile use and improving traffic flow could help improve the respiratory health of Californians. While some projects, such as rail expansions, would be very difficult to achieve by 2010, other transit improvements could have a more immediate impact. For example, expanding express bus service in many of the state's metropolitan and suburban areas can provide cost-effective, adaptable, speedy service that can be operational within 6 months of its conception.[120] Such service can maximize the efficacy of High Occupancy Vehicle lanes already established in the state's largest metropolitan areas.

Step 4: Stop Backsliding on Federal Commitments And Promote Stronger Federal Programs

Cleaning up California's polluted skies will depend on clean air laws that directly address the root of our air quality problems. Fortunately, California has been aggressive in adopting such laws, leading the nation in creating innovative programs to tackle the toughest, biggest sources of health-threatening air pollution.

This leadership has never been more important on the state level, where a delayed deadline for achieving federal standards may remove legal urgency for addressing smog pollution. It has also never been more important on a national level, where California, by upholding strongest-in-the-nation protections, empowers other states to adopt such protections in lieu of weaker, federal programs.

California will only be able to achieve the ambitious 50% reduction in health-threatening pollution if federal programs for smog pollution are not weakened, and new federal programs to curb diesel particulate emissions from federal sources are adopted.

Don't Delay Attainment of Health Standards

In response to overwhelming scientific evidence documenting that ozone is more harmful to human health than previously thought, U.S. EPA issued a stronger health standard for ozone in 1997. This stricter standard based on ozone levels over an 8-hour average replaced a weaker 1-hour standard. While this strong standard should have helped drive stronger air quality protections, EPA chose to extend deadlines for attainment of the new, stronger standard. As a result, areas of the state that failed even the weaker, 1-hour standard, such as the San Joaquin Valley and South Coast, may now be permitted to achieve attainment at a later date—as late as 2013 for the San Joaquin Valley and 2021 for the South Coast.[121]

California Clean Air Act Authorizes Earliest Possible Attainment Of Clean Air Standards

California's effort to meet federal standards is bolstered by a state law that requires air quality management districts to adopt all feasible strategies available to achieve this goal *at the earliest possible date*—the California Clean Air Act of 1988.

Although the California Clean Air Act fails to *mandate* achieving federal standards early, it clearly provides *the authority* to state agencies to adopt programs to accomplish this goal.

This legislative empowerment for state and local leadership is more important now than ever, given recent changes in federal policy. Federal standards have helped drive adoption of strong state programs to curb ozone pollution, but recent changes in how these standards will be implemented may delay the deadline for achieving these standards.

Originally, California was required to adopt pollution control programs to achieve federal health standards by 2010. Recent changes in federal law, however, may result in extending this federal deadline to 2022. Although this regulatory change gives the state more time to achieve the federal health standards, the public health consequences of delaying this progress would be significant—every year that goes by results in more illness, lost school and workdays, and loss of life.

Push for Federal Government To Do Its Part, But Don't Rely On It

According to California's proposed 2003 state implementation plan, "emission sources under the exclusive legal or practical control of the federal government account for over one-quarter of all NOx emissions and almost two-thirds of all diesel particulate matter."[122] This makes cooperation with the federal government vital to cleaning up our air. Unfortunately, the state cannot afford to rely on federal Environmental Protection Agency rulemakings to achieve its air quality objectives.

Encourage Positive Federal Action

As discussed previously, California's Diesel Risk Reduction Plan depends on federal measures to achieve a large portion of its air quality goals. This is not an attempt by the state to avoid its responsibilities—a number of emissions sources, in particular those that cross state boundaries in the process of doing daily business, are exclusively under the jurisdiction of the federal government.

Marine Craft

The 2003 California SIP lists several policies for reducing pollution from marine craft that fall under the federal EPA's jurisdiction.[123] Collaboration with the EPA and the maritime industry is vital because a majority of the ocean-going ships in California waters are foreign-flagged vessels.

CARB recommended policies aimed at new vessels, such as more stringent emissions standards for all new commercial marine vessels, harbor craft, and ocean-going vessels.[124] Estimated emission reductions in the South Coast Air Basin from these measures by 2010 would be 0.4 tons/day of ROG, 3.1 tons/day of NOx, and 0.3 tons/day of PM10.[125]

CARB also suggests that the EPA implement a number of programs aimed at existing ocean-going vessels, ranging from operational controls (e.g. requiring ships to slow down near ports) to lower sulfur fuels, and economic incentives such as charging higher port fees for the highest emitting ships.[126] Estimated emission reductions in the South Coast Air Basin from these measures by 2010 would be 1.0-1.6 tons/day of ROG, 11-17.6 tons/day of NOx, and 0.8-1.3 tons/day of PM10.[127]

Jet Aircraft

CARB calls for several approaches to reducing emissions from jet aircraft, encouraging the U.S. EPA to work with the Federal Aviation Administration and the International Civil Aviation Organization on developing new technologies and standards. Most of these efforts would mainly yield long-term reductions, but CARB estimates that the resulting emission reductions in the South Coast Air Basin in 2010 could be as much as 0.5 tons/day of ROG and 1.8 tons/day of NOx.[128]

Small Agricultural Equipment

California must rely on U.S. EPA to establish emission limits for new farm equipment less than 175 horsepower. Although preempted from taking independent state action, California is working to encourage U.S. EPA to accelerate the implementation of stringent emission standards in all 50 states based on after-treatment technologies with the goal of reducing diesel PM emissions to 90%.

Fight Bush Administration Rollbacks

The "Clear Skies" Initiative

The Bush Administration's "Clear Skies" plan would establish a credit-trading system for several dangerous pollutants, whereby power plants could either reduce their emissions or purchase credits from other polluters that have reduced their emissions more than required. The plan would also delay current deadlines for meeting cuts in emissions, and weaken important New Source Review standards (see below).

The Clear Skies plan would result in as much as 3 million tons of excess NOx pollution and 18 million tons of excess SO2 through 2012, compared to a Clean Air Act program implemented with proper enforcement.[129]

In order to justify its claim that the new plan would reduce pollution, the EPA compares it to a "base" scenario in which the Clean Air Act goes unenforced, arguing that the Clear Skies plan is better than nothing rather than describing it as a rollback.

Fortunately, the Clear Skies Act has failed to make its way through Congress. Unfortunately, the administration has pursued some of the plan's rollbacks through administrative rule changes.

New Source Review

Since 1977, the federal New Source Review (NSR) program has ensured that modern pollution controls were installed whenever an old, dirty power plant was renovated or modified in such a way that would result in more pollution.

However, in recent years the EPA has issued rule changes that effectively take the teeth out of NSR. The *New York Times* called one of the recent rule changes—which is currently being blocked by the courts—a "reckless and insupportable decision to eviscerate a central provision of the Clean Air Act and allow power plants, refineries and other industrial sites to spew millions of tons of unhealthy pollutants into the air."[130]

California responded in September 2003 by passing Senate Bill 288, the "Protect California Air Act of 2003." This law holds NSR regulations in California air quality districts to what they were on December 30, 2002. This helps ensure that potential increases in pollution undergo the same scrutiny they previously underwent.

Continue to Lead by Example

Federal Clean Air Act Authorizes California To Take National Leadership

California, alone among the 50 states, is authorized to implement stronger-than-federal air pollution standards for cars and light trucks. Other states may elect to adopt California's motor vehicle standards, but no other state may independently surpass the standards set by the federal government. For this reason, California's adoption of programs that force the development of cleaner vehicles paves the way not only for cleaner air in the state, but cleaner air in states throughout the nation.

Conclusion

Achieving the goal of cutting health-threatening smog and diesel particulate pollution by 2010 will require significant commitment of political, financial, and technical resources. Achieving the Healthy Air Goal boils down to four key components:

1. Maintain and fully enforce strong standards and programs already adopted by law.
2. Move forward with additional planned pollution controls at the earliest possible date.
3. Identify additional programs to achieve the Healthy Air goal.
    a. Allocate $350 million in annual funding for incentives to accelerate the transition to cleaner, safer engines.
    b. Consider adoption of congestion management pricing, VMT fees, or other programs to reduce gasoline combustion such as mass transit and land use policies. In sum, such programs can be revenue neutral.
4. Continue to leverage California's leadership to prevent federal rollbacks of Clean Air laws and regulations. Most notably, maintain rigorous deadlines for achieving federal health standards for smog and soot, despite new loopholes that would allow lax compliance.

Methodology

This report focuses on emissions from sources under state and federal regulation. Therefore, unless otherwise noted, emissions inventory estimates and trends are based on these sources, not natural sources or sources uniquely under jurisdiction of local air quality management districts. For this reason, mobile source emissions and area sources are the prime categories under consideration. Furthermore, categories such as paved road dust and unpaved road dust, while relevant to overall ambient levels of particulate matter, were excluded from this analysis by focusing on diesel particulates.

In addition, throughout the report, South Coast planning inventory estimates for emissions reductions achievable by planned programs are used to calculate statewide emissions reductions for programs that have not yet been calculated by the Air Resources Board or have not yet been made widely available to the public. For example, if the State Implementation Plan for ozone in the South Coast stipulates additional measures will be adopted to curb emissions from consumer products by 5 tons per day from projected 2010 levels of 100 tons per day, this measure is expected to result in a 5% reduction from 2010 levels. We then apply that 5% reduction to statewide projected 2010 emissions to estimate the potential statewide pollution-reduction impact of measures included in the South Coast SIP. Statewide rates of emission reductions from various policies may differ somewhat from reduction rates in the South Coast, but the use of South Coast estimates provides a rough sense of the degree to which various policies can reduce pollution statewide, as well as an accurate sense of the degree to which they can reduce pollution in California's most populous region. We used statewide inventory estimates and projections for the years 2003 and 2010 available online through the state's 2003 Almanac of Emissions and Air Quality.

Estimates of emission reductions achievable through reinstating Carl Moyer Funding are derived from CARB analyses.[131] Table 9 shows estimated funding needs assuming that future emissions reductions are more expensive than emissions reductions already achieved by Carl Moyer.

Calculating Air Pollution Reductions Achievable by Carl Moyer Funding

Annual program funding (millions)	7% growth in cost		10% growth in cost		15% growth in cost	
	Tons/day reduction	% of 2003 statewide emissions	Tons/day reduction	% of 2003 statewide emissions	Tons/day reduction	% of 2003 statewide emissions
$100	74	2.2%	68	2.1%	59	1.8%
$200	150	4.5%	140	4.2%	120	3.6%

$300	220	6.6%	200	6.0%	180	5.4%

Endnotes

1 "Schwarzenegger Action Plan for California's Environment," October 2003, downloaded 5 May 2004 from www.ecovote.org/involved/arnold_platform.html

2 "Action Plan for California's Environment," 21 September 2003, www.joinarnold.com/en/agenda/, as downloaded on 8 January 2004.

3 Mel Zeldin, CAPCOA, "The Carl Moyer Program and Other Incentive Programs in California: Preliminary Bounding Estimates for Future Needs," February 2004.

4 American Lung Association, "State of the Air 2004: California: Sensitive Populations," downloaded from lungaction.org/reports/SOTA04_statesensitive.html?geo_area_id=06 on 5 May 2004.

5 California Air Resources Board, "Asthma and Air Pollution," last updated 9 June 2003.

6 California Air Resources Board, "Children's Health Study," on the web at www.arb.ca.gov/research/chs/chs.htm.

7 UCLA School of Public Health, "UCLA School of Public Health to Lead Consortium Addressing Effects of Air Pollution on Asthma Epidemic," 16 March 2004.

8 2004 SIP Summit, "Overview of the State Implementation Plan," 13 January 2004, p.2.

9 California Air Resources Board, Final Diesel Risk Reduction Plan, p.15, Table 6, October 2000, downloadable on the web at www.arb.ca.gov/diesel/documents/rrpapp.htm; 36 million Californians according to California Department of Finance Demographic Research Unit x 450 cancers/per million exposed= 16,200 additional lifetime cancers.

10 California Air Resources Board, Final Diesel Risk Reduction Plan, Appendix VII: Risk Characterization Scenarios, October 2000, downloadable on the web at www.arb.ca.gov/diesel/documents/rrpapp.htm

11 California Air Resources Board, "Diesel Engines and Alternatives," 2004 SIP Summit, 13 January 2004, on the web at www.arb.ca.gov/planning/sip/sipsummit/2004/day1c_diesel_eng_and_alts.pdf.

12 American Lung Association, "State of the Air 2004," downloadable on the web at www.lungusa.org.

13 California Air Resources Board

14 "ROG" is generally used by the California Air Resources Board, "VOC" is generally used US EPA, but these terms are generally interchangeable for most uses. For a full treatment of definitions of VOC and ROG, see arbis.arb.ca.gov/emisinv/speciate/ROG_DFN_8_00.pdf

15 California Air Resources Board

16 California Air Resources Board, Stationary Source Division Emissions Assessment Branch, "Airborne Toxic Control Measure For In-Use Diesel-Fueled Transport Refrigeration Units (TRU) And TRU Generator Sets, And Facilities Where TRUs Operate," October 2003.

17 CARB projected reductions in diesel particulate emissions, made in 2000, assuming no further actions taken.

18 California Air Resources Board Almanac web page, "2004 Almanac Table 5-21 2003 Top Ten Counties: Diesel Particulate Matter," p.248, downloaded 15 June 2004 from www.arb.ca.gov/aqd/almanac/almanac04/almanac04.htm

19 California Air Resources Board, "Almanac of Emissions and Air Quality, 2002."

20 Based on total 2003 smog-forming emissions of 5921 tpd (2004 Almanac Data), 36 million state residents.

21 3850 to 4000 tpd based on extrapolations from South Coast SIP.

22 California Air Resources Board Almanac, 2003 California Emissions Inventory Data, Statewide Estimated Annual Average Emissions, "2003 Emissions by Major Source Category," source data appended in Methodology.

23 California Air Resources Board Almanac, 2003 California Emissions Inventory Data, Statewide Estimated Annual Average Emissions, "2003 Emissions by Major Source Category," source data appended in Methodology.

24 California Air Resources Board Almanac web page, "2004 Almanac Table 5-21 2003 Top Ten Counties: Diesel Particulate Matter," p.256, downloaded 15 June 2004 from www.arb.ca.gov/aqd/almanac/almanac04/almanac04.htm.

25 Based on CARB initial projections of 22,700 tons per year, as presented in California Air Resources Board, Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles, October 2000.

26 See methodology for exact program details, derived from California Air Resources Board, Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles, October 2000.

27 Locomotives and commercial marine vessels are sources under US EPA regulation, and therefore are listed separately from potential state initiatives.

28 Based on analysis of South Coast Air Quality Planning Inventory, Summer emissions for ROG and NOx.

29 Emfac 2002, version 2.2 finalized 23 April 2003, scenario for statewide summer emissions from all light-duty mobile sources. Paul Hughes, California Air Resources Board, personal communication, 16 April 2004.

30 Emfac 2002, version 2.2 finalized 23 April 2003, scenario for statewide summer emissions from all light-duty mobile sources. Paul Hughes, California Air Resources Board, personal communication, 16 April 2004.

31 Emfac 2002, version 2.2 finalized 23 April 2003, scenario for statewide summer emissions from all light-duty mobile sources. Paul Hughes, California Air Resources Board, personal communication, 16 April 2004.

32 California Air Resources Board, Fact Sheet: Reducing Emissions from California Vehicles, 23 February 2004.

33 California Air Resources Board, Fact Sheet: 2003 Zero Emission Vehicle Program Changes, 18 March 2004.

34 The reasons behind the lack of market success of the EV-Plus, EV1, and similar electric vehicles are complex, and have much to do with automakers' failure to properly market their vehicles to the public. For a more detailed discussion of this issue, please see Tony Dutzik, MASSPIRG Education Fund, Ready to Roll: An Assessment of Massachusetts' Preparedness for the Zero Emission Vehicle Program, March 2002.

35 Emfac 2002, version 2.2 finalized 23 April 2003, scenario for statewide summer emissions from all light-duty mobile sources. Paul Hughes, California Air Resources Board, personal communication, 16 April 2004.

36 INEEL, 'California governor opens way to 'Hydrogen Highway'" www.inel.gov/whats_new/05-04-04-1.shtml, last updated 4 May 2004.

37 Based on US EPA eGRID Database, Version 2.01, year 2000 data, published May 2003, showing 103,250,299 MWh annual natural gas power generation at an average emission rate of 0.72 lbs NOx per megawatt/hour.

38 Based on percentage reduction in vehicle emissions from M.Q. Wang, Argonne National Laboratory, Development and Use of GREET 1.6 Fuel Cycle Model for Transportation Fuels and Vehicle Technologies, June 2001, compared with baseline emissions from future technology vehicles fueled with California reformulated gasoline from Michael Wang, Argonne National Laboratory, GREET Model 1.6 (draft), October 2002.

39 California Environmental Protection Agency, California Air Resources Board, The 2003 Amendments to the California Zero Emission Vehicle Program Regulations: Final Statement of Reasons, January 2004, 38.

40 Ed Garston, Detroit News, "GM Says Fuel Cell Cars Will Be Ready by 2010," 11 February 2003.

41 U.S. Department of Energy, Fuel Cell Report to Congress, February 2003.

42 Northeast Advanced Vehicle Consortium, Future Wheels II: A Survey of Expert Opinion on the Future of Transportation Fuel Cells and Fuel Cell Infrastructure, September 2003.

43 California Air Resources Board, "2003 Emissions By Major Source Category," California Emission Inventory Data, downloaded 7 June 2004 from www.arb.ca.gov

44 http://www.epa.gov/otaq/regs/hd-hwy/2000frm/f00026.pdf

45 California Air Resources Board, Regulations for On-Road Motorcycles, 19 February 2004.

46 California Air Resources Board, Staff Report: Initial Statement of Reasons, Proposed Amendments to the California On-Road Motorcycle Regulation, 23 October 1998.

47 Department of Consumer Affairs, Bureau of Automotive Repair, Do I Really Need a Smog Check?, 2003.

48 California Air Resources Board and Department of Consumer Affairs Bureau of Automotive Repair, Evaluation of the California Enhanced Vehicle Inspection and Maintenance (Smog Check) Program; Draft Report to the Inspection and Maintenance Review Committee, April 2004.

49 Department of Consumer Affairs, Bureau of Automotive Repair, Inspection and Maintenance Programs in California Fact Sheet, 2003.

50 Department of Consumer Affairs, Bureau of Automotive Repair, Do I Really Need a Smog Check?, 2003.

51 California Air Resources Board, On-Road Emission Model Methodology Documentation, downloaded from www.arb.ca.gov/msei/on-road/doctable_test.htm, 3 May 2004.

52 California Air Resources Board, "Offroad Status Review," 24 October 2002.

53 California Air Resources Board, Public Hearing to Consider Adoption of Emission Standards and Test Procedures for New 2003 and Later Spark-Ignition Inboard and Sterndrive Marine Engines, 8 June 2001.

54 California Air Resources Board, Proposed 2003 State and Federal strategy for California SIP, Section II: Mobile Sources (Revised), 25 August 2003.

55 California Air Resources Board, Proposed 2003 State and Federal strategy for California SIP, Section I: Overview of Commitments (Revised), 25 August 2003.

56 Most of these engines can be regulated by the state; farm and construction equipment of less than 175 horsepower are regulated by U.S. EPA only.

57 California Air Resources Board, Public Hearing to Consider Adoption of Emission Standards and Test Procedures for New 2001 and Later Off-Road Large Spark-Ignition Engines, 4 September 1998.

58 RULEMAKING ON THE SMALL OFF-ROAD EXHAUST AND EVAPORATIVE EMISSIONS CONTROL REGULATIONS (September 25, 2003 Hearing)

59 AB10x Fact Sheet

60 California Air Resources Board, Proposed 2003 State and Federal strategy for California SIP, Section III: Consumer Products, Vapor Recovery, and Pesticides (Revised), 25 August 2003.

61 California Air Resources Board, Proposed 2003 State and Federal strategy for California SIP, Section III: Consumer Products, Vapor Recovery, and Pesticides (Revised), 25 August 2003.

62 California Air Resources Board, Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles, October 2000.

63 California Air Resources Board, Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles, October 2000.

64 For clarity of presentation, we have combined three stationary source measures contributing a total of 2% of projected reductions.

65 California Air Resources Board, Proposed Amendments to the California Diesel Fuel Regulations, appendix E, 6 June 2003.

66 California Air Resources Board, The California Diesel Fuel Regulations, downloaded from www.arb.ca.gov/fuels/diesel/diesregs.pdf, 4 May 2004.

67 http://www.arb.ca.gov/planning/agriculture/dieselpm/lsdffactsht.pdf

68 California Air Resources Board, Fact Sheet: Children's School Bus Exposure Study, October 2003, on the web at www.arb.ca.gov/research/schoolbus/sbfact.pdf.

69 ARB, "LOWER-EMISSION SCHOOL BUS PROGRAM," May 2004, p.12.

70 California Air Resources Board, Resolution 02-30, 24 October 2002.

71 California Air Resources Board, "Staff Report: Initial Statement Of Reasons, Proposed Diesel Particulate Matter Control Measure For On-Road Heavy-Duty Residential And Commercial Solid Waste Collection Vehicles," p.3, 9 August 2003

72 *Value of near-term defined measures outlined in SIP.

73 California Air Resources Board, Proposed 2003 State and Federal strategy for California SIP, Section III: Consumer Products, Vapor Recovery, and Pesticides (Revised), 25 August 2003.

74 For more information on consumer product rules, contact dmallory@arb.ca.gov

75 California Air Resources Board, "Rulemaking On The Adoption Of The Heavy-Duty Diesel Engine Software Upgrade Regulation (Chip Reflash)" 25 March 2004.

76 California Air Resources Board, Proposed 2003 State and Federal strategy for California SIP, Section II: Mobile Sources (Revised), 25 August 2003.

77 Miguel Bustillo, "Clean Air Rules May Become Optional," Los Angeles Times, 25 March 2004.

78 California Air Resources Board, "Staff Report: Initial Statement of Reasons (ISOR), Rulemaking On The Proposed Adoption Of Heavy-Duty Vehicle Idling Emission Reduction Requirements," 22 January 2004.

79 http://www.capcoa.org/Presentations/Day02/13%20Donohoue.pdf

80 hwww.capcoa.org/Presentations/Day02/13%20Donohoue.pdf

81 California Air Resources Board, Stationary Source Division Emissions Assessment Branch, "AIRBORNE TOXIC CONTROL MEASURE FOR IN-USE DIESEL-FUELED TRANSPORT REFRIGERATION UNITS (TRU) AND TRU GENERATOR SETS, AND FACILITIES WHERE TRUs OPERATE," October 2003.

82 California Air Resources Board, The Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines, 30 September 2003.

83 California Air Resources Board, as cited by Mel Zeldin, California Air Pollution Control Officer's Association, The Carl Moyer Program and Other Incentive Programs in California: A Background Summary and Preliminary Bounding Estimates for Future Needs, February 2004.

84 California Air Resources Board, The Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines, 30 September 2003, 16.

85 California Air Resources Board, as cited by Mel Zeldin, California Air Pollution Control Officer's Association, The Carl Moyer Program and Other Incentive Programs in California: A Background Summary and Preliminary Bounding Estimates for Future Needs, February 2004.

86 California Air Resources Board, The Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines, 30 September 2003, 76.

87 California Air Resources Board, as cited by Mel Zeldin, California Air Pollution Control Officer's Association, The Carl Moyer Program and Other Incentive Programs in California: A Background Summary and Preliminary Bounding Estimates for Future Needs, February 2004.

88 California Air Resources Board, as cited by Mel Zeldin, California Air Pollution Control Officer's Association, The Carl Moyer Program and Other Incentive Programs in California: A Background Summary and Preliminary Bounding Estimates for Future Needs, February 2004.

89 California Air Resources Board, as cited by Mel Zeldin, California Air Pollution Control Officer's Association, The Carl Moyer Program and Other Incentive Programs in California: A Background Summary and Preliminary Bounding Estimates for Future Needs, February 2004.

90 California Air Resources Board, as cited by Mel Zeldin, California Air Pollution Control Officer's Association, The Carl Moyer Program and Other Incentive Programs in California: A Background Summary and Preliminary Bounding Estimates for Future Needs, February 2004.

91 Carl Moyer Program Advisory Board, The Carl Moyer Program Advisory Board Report, 31 March 2000.

92 California Air Resources Board, The Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines, 30 September 2003.

93 California Air Resources Board, The Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines, 30 September 2003.

94 California Air Resources Board, The Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines, 30 September 2003.

95 California Air Resources Board, The Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines, 30 September 2003.

96 California Air Resources Board, The Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines, 30 September 2003.

97 Charles Kersey, California Air Resources Board, personal communication, 20 April 2004.

98 Charles Kersey, California Air Resources Board, personal communication, 20 April 2004.

99 California Air Resources Board, The Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines, 30 September 2003.

100 Mel Zeldin, California Air Pollution Control Officer's Association, The Carl Moyer Program and Other Incentive Programs in California: A Background Summary and Preliminary Bounding Estimates for Future Needs, February 2004.

101 See methodology for calculations.

102 California Air Resources Board, Final Diesel Risk Reduction Plan, October 2000, downloadable on the web at www.arb.ca.gov/diesel/documents/rrpapp.htm

103 California Air Resources Board, "The Carl Moyer Program Annual Status Report," p. 36, March 2002, on the web at www.arb.ca.gov/msprog/moyer/2002report.pdf.

104 Analysts estimate that this program reduced 4,132 tpy of NOx emissions annually over its first three years, during the same time that 212 tpy PM emissions were reduced. Based on this ratio, of 19.5 tpy NOx reductions for every 1 tpy PM reductions, we estimate 10.3 tpd PM emissions reductions could be achieved along with 200 tpd NOx emissions.

105 California Air Resources Board, Resolution 00-44, December 2000.

106 ARB, "LOWER-EMISSION SCHOOL BUS PROGRAM," May 2004.

107 ARB, "LOWER-EMISSION SCHOOL BUS PROGRAM," May 2004.

108 1683 tpd out of 3471 tpd statewide in 2010 based on 2004 Almanac.

109 Projections from CA DOT, 2003, www.dot.ca.gov/hq/tsip/TSIPPDF/MVSTAFF03.pdf.

110 For example, see John Holtzclaw, "Using Residential Patterns and Transit to Decrease Auto Dependence and Costs," NRDC, June 1994.

111 "Action Plan for California's Environment," 21 September 2003, www.joinarnold.com/en/agenda/, as downloaded on 8 January 2004.

112 Air Resources Board," Research Notes: Can Transportation Pricing Strategies Be Used for Reducing Emissions?" June 1998.

113 Cutting VMT in growth in half through 2010 would result in roughly 350 billion rather than 380 billion, an 8% reduction from projected levels. Applying 8% reduction to emissions of 1683 tpd equals 135 tpd of averted emissions.

114 Todd Litman, "London Congestion Pricing," Victoria Transport Policy Institute, 18 February 2004.

115 Metropolitan Transportation Authority, "Draft 2004 Congestion Management Program," January 2004.

116 Air Resources Board, Research Notes: "Can Transportation Pricing Strategies Be Used for Reducing Emissions?" June 1998.

117 Joseph Daniel, "The Environmental Impact of Highway Congestion Pricing," 1998.

118 Greig Harvey, Elizabeth Deakin, Randall Pozdena and Geoffrey Yarema, "Transportation Pricing Strategies for California: An Assessment of Congestion, Emissions, Energy and Equity Impacts," California Environmental Protection Agency, Air Resources Board Research Division, Draft Final Report, Sacramento, CA, June 1995, as cited and presented by Kenneth Green, "Checking up on Smog Check," Reason Public Policy Institute, March 1997.

119 http://www.osti.gov/fcvt/deer2001/friedman.pdf

120 Surface Transportation Policy Project, "Public Transit: Express Buses: A Low Cost Cure for Congestion,"

121 USEPA, "8-Hour Ground-Level Ozone Designations in EPA Region 9," 15 April 2004, www.epa.gov/region09/air/ozonedesignations/

122 California Air Resources Board, Proposed 2003 State and Federal Strategy for the California State Implementation Plan, 25 August 2003.

123 California Air Resources Board, Proposed 2003 State and Federal Strategy for the California State Implementation Plan, 25 August 2003.

124 California Air Resources Board, Proposed 2003 State and Federal Strategy for the California State Implementation Plan, 25 August 2003, II-G-18.

125 California Air Resources Board, Proposed 2003 State and Federal Strategy for the California State Implementation Plan, 25 August 2003, II-G-21.

126 California Air Resources Board, Proposed 2003 State and Federal Strategy for the California State Implementation Plan, 25 August 2003, II-G-21

127 California Air Resources Board, Proposed 2003 State and Federal Strategy for the California State Implementation Plan, 25 August 2003, II-G-25.

128 California Air Resources Board, Proposed 2003 State and Federal Strategy for the California State Implementation Plan, 25 August 2003, II-H-13.

129 Clean Air Now, Doing the Math: More Pollution than the Clean Air Act (fact sheet), downloaded from cleanairnow.org, 6 May 2004.

130 "Politics and pollution," New York Times, 28 August 2003.

131 Charles Kersey, California Air Resources Board, personal communication, 20 April 2004.