IV.

EMISSIONS

California's extreme air quality problems require unique strategies for meeting federal and state ambient air quality standards. In this Chapter we provide an overview of these air quality problems and the need for significant emission reductions from all sources of air pollution. We also describe the need for the regulation of consumer products and provide a summary of the emissions from the categories proposed for regulation, for a detailed summary of the product categories see Chapter VI.

A. AMBIENT AIR QUALITY AND THE NEED FOR EMISSIONS REDUCTIONS

Volatile organic compound (VOC) emissions contribute to the formation of both ozone and fine particulate matter (PM). Ozone formation in the lower atmosphere results from a series of chemical reactions between VOCs and nitrogen oxides in the presence of sunlight. PM is the result of both direct and indirect emissions. Direct sources of PM include emissions from fuel combustion and wind erosion of soil. Indirect PM emissions result from the chemical reaction of VOCs, nitrogen oxides, sulfur oxides and other chemicals in the atmosphere. Federal and state ambient air quality standards for these contaminants have been established to protect California's population from the harmful effects of ozone and PM.

Ozone

VOCs and nitrogen oxides (NO_x) react in the presence of sunlight to form ozone. The rate of ozone generation is related closely to both the amount and reactivity of VOC emissions as well as the amount of NO_x emissions available in the atmosphere (U.S. EPA, 1996; Seinfeld and Pandis, 1998). Ozone is a colorless gas and the chief component of urban smog. It is one of the state's more persistent air quality problems. Air quality data have revealed that 75 percent of the nation's exposure to ozone occurs in California (ARB, 1994). As shown in Figure IV-1, the population-weighted average exposure to ozone concentrations above the state ambient air quality standard (of 0.09 parts per million) in the South Coast Air Basin has been declining. However, despite this decline and nearly 25 years of regulatory efforts, ozone continues to be an important environmental and health concern.

It has been well documented that ozone adversely affects the respiratory functions of humans and animals. Human health studies show that short-term exposure to ozone injures the lung (ARB, 2000b, 1997; U.S. EPA, 1996). In some animal studies, permanent structural changes with long-term exposures to ozone concentrations considerably above ambient were noted; these changes remain even after periods of exposure to clean air (U.S. EPA, 1996). Ozone is a strong irritant that can cause constriction of the airways, forcing the respiratory system to work harder in order to provide oxygen to the body. Ozone is a powerful oxidant that can damage the respiratory tract, causing inflammation and irritation, and induces symptoms such as coughing, chest tightness, shortness of breath, and worsening of asthma symptoms (U.S. EPA, 1996). Ozone in sufficient doses increases the permeability of lung cells, rendering them more susceptible to toxins and microorganisms.

The greatest risk is to those who are more active outdoors during smoggy periods, such as children, athletes, and outdoor workers. Exposure to levels of ozone above the current ambient air standard leads to lung inflammation and lung tissue damage, and a reduction in the amount of air inhaled into the lungs. Recent evidence has, for the first time, linked the onset of asthma to exposure to elevated ozone levels in exercising children (McConnell 2002).

Over the past 10 years, the ARB has conducted the "Epidemiologic Investigation to Identify Chronic Health Effects of Ambient Air Pollutants in Southern California," a long-term study that is documenting the lung development of children in 12 cities in California (also know as the "Children's Health Study"). The air quality in these 12 communities varies from good to moderate and poor, so any trends in lung development may be determined. A final report on the Children's Health Study will be available at the end of May 2004. Major results of the study include the following findings:

- Children that have been exposed to current levels of air pollution have significantly reduced lung growth and development when exposed to higher levels of acid vapor, ozone, nitrogen dioxide and particulate matter which is made up of very small particles that can be breathed deeply into the lungs (Gauderman *et al.,* 2002).

- Children living in high ozone communities who actively participate in several sports are more likely to develop asthma than children in these communities not participating in sports (McConnell *et al.,* 2002).

- Children living in communities with higher concentrations of nitrogen dioxide, particulate matter, and acid vapor have lungs that develop and grow more slowly and are less able to move air through them (Gauderman *et al.,* 2002, 2000). This decreased lung development may have permanent adverse effects in adulthood.

- Children who moved away from study communities had increased lung development if the new communities had lower particulate matter levels, and had decreased lung development if the new communities had higher particulate matter levels (Avol *et al.,* 2001).

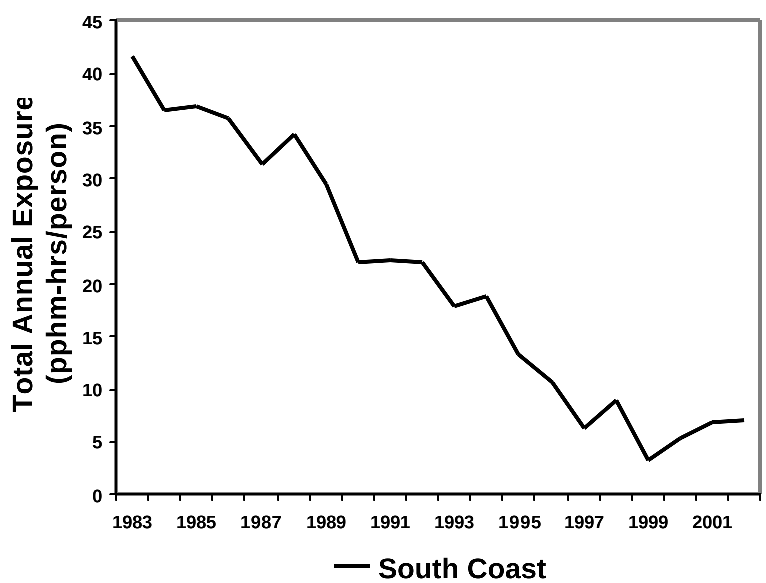
- Days with higher ozone concentrations resulted in significantly higher school absences due to respiratory illness (Gilliland *et al.,* 2000).

- Children with asthma who are exposed to higher levels of particulate matter are much more likely to develop bronchitis (McConnell *et al.,* 2003).

In addition, staff of the ARB and the Office of Environmental Health Hazard Assessment (OEHHA) are currently reviewing the scientific literature on public exposure, atmospheric chemistry, and health effects of exposure to ozone. This work follows a preliminary evaluation of all health-based ambient air quality standards in December 2000 to determine their adequacy to protect public health, particularly that of infants and children required by The Children's Environmental Health Protection Act (Senate Bill 25, Escutia, 1999).

One requirement of The Children's Environmental Health Protection Act is that the ARB, in consultation with OEHHA, review all of California's health-based ambient air quality standards by December 31, 2000 (Senate Bill 25, Escutia, 1999). The purpose of the review was to determine whether the standards adequately protect public health, especially the health of infants and children. The findings are summarized in the report, "Adequacy of California Ambient Air Quality Standards: Children's Environmental Health Protection Act" (ARB, 2000b). This report found that the standards for particulate matter, ozone, and nitrogen dioxide are inadequate to protect public health. The standards for particulate matter (PM10 and sulfates) were found to have the highest priority for revision. At its December 9, 2000, Public Meeting, the Board approved the report and urged staff to work as expeditiously as possible to present them with recommendations due to the serious impact of these pollutants on the health of Californians.

Figure IV-1
Population-Weighted Exposure to Ozone Concentrations Above the State Ambient Air Quality Standard



Not only does ozone adversely affect human and animal health, but it also affects vegetation throughout most of California resulting in reduced yield and quality in agricultural crops, disfiguration or unsatisfactory growth in ornamental vegetation, and damage to native plants. During the summer, ozone levels are often highest in the urban centers in Southern California, the San Joaquin Valley, and Sacramento Valley, which are adjacent to the principal production areas in the state's multibillion-dollar agricultural industry. ARB studies indicate that ozone pollution damage to crops is estimated to cost agriculture over 300 million dollars annually (ARB, 1987). Similarly, the U.S. EPA estimates national agricultural losses to exceed 1 billion dollars annually (U.S. EPA, 1996). Elevated levels of ozone also cause damage to materials such as rubber, paints, fabric, and plastics.

Fine Particulate Matter

Fine particulate matter (PM) is prevalent in the urban atmosphere (see, for example, Pandis *et al.,* 1992), and ambient PM, especially those with aerodynamic diameters less than two and a half micrometers ($PM_{2.5}$) is known to have negative impacts on human health (Schwartz *et al*., 1996; Moolgavkar and Luebeck, 1996). Like ozone, PM can be formed via atmospheric oxidation of organic compounds (Finlayson-Pitts and Pitts, 2000). According to the results from several recent studies, photochemically derived PM (i.e. secondary organic aerosol) could contribute up to 80 percent of the fine particle burden observed in severe air pollution episodes (Pandis *et al.,* 1992; Turpin and Huntzicker, 1991, 1995). In urban PM, these secondary organic aerosols could produce effects such as visibility degradation and toxicity (see, for example Atkinson and Arey, 1994).

Significant advances have been made in the theoretical and the experimental studies of the formation of secondary organic aerosols (SOA) (Pankow, 1994a, 1994b; Odum *et al.,* 1996; Seinfeld and Pandis, 1998; Harner and Bidleman, 1998; Kleindienst, *et al.,*1999; Yu *et al.,* 1999). In addition, modeling techniques to determine the amount of ozone as well as the amount of aerosol formed from a VOC have been established (Bowman *et al.,* 1995), and the concept similar to maximum incremental reactivity is being applied to quantitatively assess the aerosol formation potential of a VOC (i.e. incremental aerosol reactivity) (Griffin *et al.,* 1999). Based on the results of these studies, we now know that there is a mechanistic linkage between the ozone formation and SOA formation of a VOC.

Although most organic compounds contribute to ozone formation (Carter, 2000), secondary organic aerosol is usually formed from photooxidation of organic compounds with carbon numbers equal to seven or more (Grosjean and Seinfeld, 1989; Wang *et al.,*1992). This observation is consistent with the fact that both reactivity and product's volatility need to be considered for evaluating the aerosol formation potential of a VOC (Odum *et al.*, 1997). It has also been shown that aromatic compounds are more likely to participate in the formation of SOA than are alkanes (Grosjean, 1992; Pandis *et al.,* 1992). In other words, only chemicals which react fast enough in the atmosphere will generate sufficient amounts of low volatility products for forming aerosols.

Airborne PM can be solid or liquid in form, and can be directly emitted into the atmosphere as the result of anthropogenic actions such as fuel combustion or natural causes such as wind erosion. PM_{10} (PM with less than (<) 10 microns determined as the equivalent aerodynamic diameter) can cause adverse health effects and also contributes to reduced visibility. PM_{10}, and specifically, its smaller fraction, $PM_{2.5}$, can be inhaled deep into the lungs and also disrupt cellular processes. The particulate matter irritates the respiratory tract, and may contain toxic as well as carcinogenic compounds (Godish, 1991). Premature deaths linked to particulate matter are now at levels comparable to traffic accidents and second-hand smoke (ARB 2002a).

Population-based studies in hundreds of cities in the United States and around the world have demonstrated a strong link between elevated particulate levels and premature deaths, hospital admissions, emergency room visits and asthma attacks. These studies indicate that certain populations are particularly sensitive to PM, including the elderly, persons suffering from lung or cardiopulmonary disease, infants and children, and asthma sufferers. Among children, decrements in lung function occur, leading to increased school absences, and asthmatic individuals may suffer from increased respiratory symptoms. Among the elderly and in individuals suffering from cardiopulmonary disease, exacerbation of chronic disease leading to increased hospital admissions are seen (U.S. EPA, 1997). Groundbreaking long-term studies of children's health conducted in California have demonstrated that particle pollution may significantly reduce lung function growth in children (Peters *et al.,* 1999, Avol *et al.,* 2001, Gauderman *et al.,* 2002).

The findings of the ARB and OEHHA report, "Adequacy of California Ambient Air Quality Standards: Children's Environmental Health Protection Act" found that the standards for particulate matter (PM10 and sulfates) have the highest priority for revision (ARB, 2000b). At a December 9, 2000, Public Meeting, the ARB approved the report and urged staff to work as expeditiously as possible to present them with recommendations due to the serious impact of these pollutants on the health of Californians. On June 20, 2002, the Board adopted staff's recommendations, and the revised standards became effective on July 5, 2003. The revised PM_{10} standard is 20 $\mu g/m^3$ for an annual average. In addition, the ARB adopted a fine PM ($PM_{2.5}$) standard (particles with a mean aerodynamic diameter of 2.5 microns or less), set at 12 $\mu g/m^3$ for an annual average.

The Federal and state ambient air quality standards for ozone and PM are shown in Table IV-1. The state hourly ozone standard is 0.09 parts per million (ppm) and the national hourly ozone standard is 0.12 ppm. The state PM_{10} standard for a 24-hour period is 50 micrograms per cubic meter ($\mu g/m^3$), and the national standard is 150 $\mu g/m^3$ over a 24 hour period.

Table IV-1
Ambient Air Quality Standards for Ozone and PM_{10}

Pollutant	Averaging Time	State Standard	National Standard
Ozone	1 hour	0.09 ppm (180 $\mu g/m^3$)	0.12 ppm (235 $\mu g/m^3$)
	8 hour	---------	0.08 ppm (157 $\mu g/m^3$)
PM_{10}	24 hour Annual Annual Arithmetic Mean	50 $\mu g/m^3$ 20 $\mu g/m^3$	150 $\mu g/m^3$ 50 $\mu g/m^3$
$PM_{2.5}$	24 hour Annual Annual Arithmetic Mean	--------- 12 $\mu g/m^3$	65 $\mu g/m^3$ 15 $\mu g/m^3$

In 1997, the U.S. EPA promulgated a new 8-hour ozone ambient air quality standard (U.S. EPA, 1997). However, a court decision put implementation of the new standard on hold until legal challenges were resolved. On April 15, 2004, U.S. EPA designated nonattainment areas for the new eight-hour ozone standard effective June 15, 2004 (U.S. EPA, 2004a, 2004b). In California, many of these areas are already nonattainment for the federal 1-hour standard. New nonattainment areas include a number of rural Sierra foothill counties and additional parts of the Sacramento Valley. This action starts the transition from the one-hour standard to the eight-hour standard. The one-hour standard will be revoked on June 15, 2005, one year after the effective date of the designation.

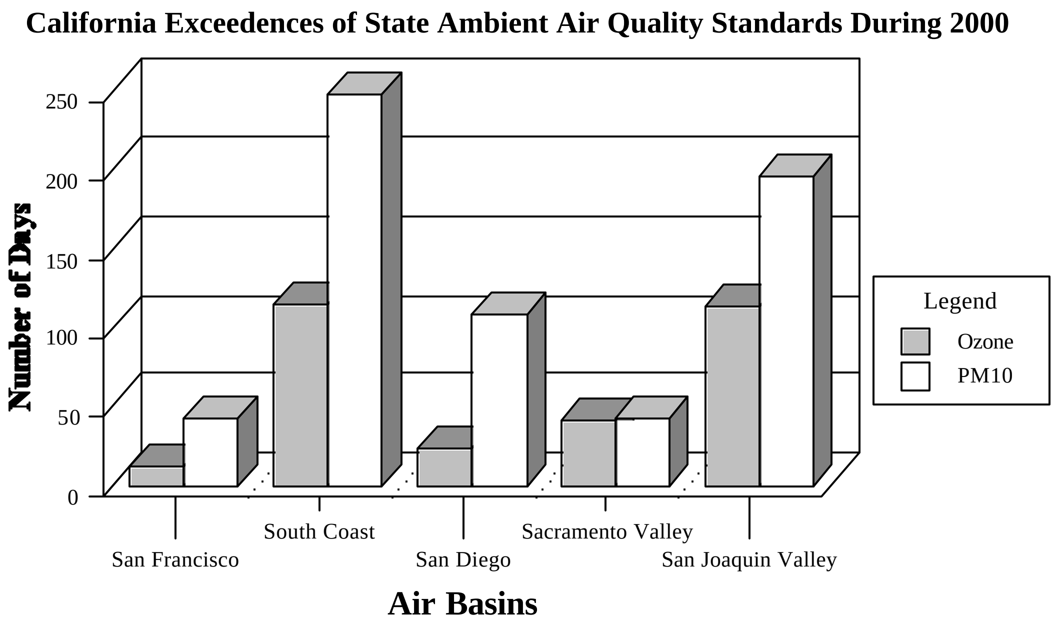
State implementation plans (SIPs) showing how each area will meet the federal eight-hour standard are due by 2007. In order to maintain progress towards clean air, the Clean Air Act prohibits backsliding on the control program. Since the eight-hour standard is more health-protective than the federal one-hour standard, ARB expects that California will need to reduce emissions beyond the existing one-hour SIP targets. All major urban areas in California continue to violate the federal and state ozone standards, and need additional emission reductions in ozone precursors – such as VOC's – to attain these health-based standards.

The U.S. EPA also recently adopted standards for particulate matter less than 2.5 microns ($PM_{2.5}$) in addition to the PM_{10} standards (U.S. EPA, 1997). $PM_{2.5}$ consists of directly emitted particulate matter, and secondary particulate matter such as nitrates, sulfates and condensibles that are formed in the atmosphere from precursors such as NOx, ammonia, SOx and complex hydrocarbons. Because $PM_{2.5}$ is a subset of PM_{10}, these precursors contribute to PM_{10} pollution as well. In 2002, California established an annual average $PM_{2.5}$ standard of 12 $\mu g/m^3$, which is more health-protective than the federal standard (15$\mu g/m^3$).

The court decision also affects the particulate matter standards. However, U.S. EPA set the implementation schedule for the $PM_{2.5}$ standards on a time line to allow the agency to complete its next review of the particulate matter standards in 2002 prior to designating non-attainment areas and requiring implementation plans for $PM_{2.5}$. The review of the PM standards is still ongoing with intent to make the final rulemaking on PM at the end of 2005. With this lengthy time line, we expect the legal challenges and uncertainty regarding the $PM_{2.5}$ standards to be resolved. Meanwhile, PM_{10} non-attainment areas will continue to implement their plans to attain the pre-existing PM_{10} standards.

The vast majority of California's population who live in urban areas breathe unhealthy air for much of the year, in Figure IV-2 shows the number of days the State AAQS were exceeded in 2000 in several air basins in California (ARB, 2003). Lastly, Figures IV-3 and IV-4 show that unhealthy levels of ozone and PM_{10}, respectively, are not limited to just urban areas, but can be found in nearly every county in California. As shown in these maps for 2002, 46 counties are currently designated as nonattainment (or nonattainment-transitional, which is a subcategory of nonattainment) for the state ozone standard, while 54 counties are designated as nonattainment for the state PM_{10} standard (ARB, 2002b). These counties contain over 98 and 99 percent, respectively, of California's population in 2002, a clear indication of the extent and magnitude of the ozone and PM_{10} problems in California. Figures IV-5 and IV-6 show maps identifying counties not in attainment with the federal standards.

Figure IV-2



California Exceedences of State Ambient Air Quality Standards During 2000
Number of Days
250
200
150
100
50
0
San Francisco
South Coast
San Diego
Sacramento Valley
San Joaquin Valley
Air Basins
Legend
Ozone
PM10

Figure IV-3
Area Designations for State Ambient Air Quality Standard for Ozone

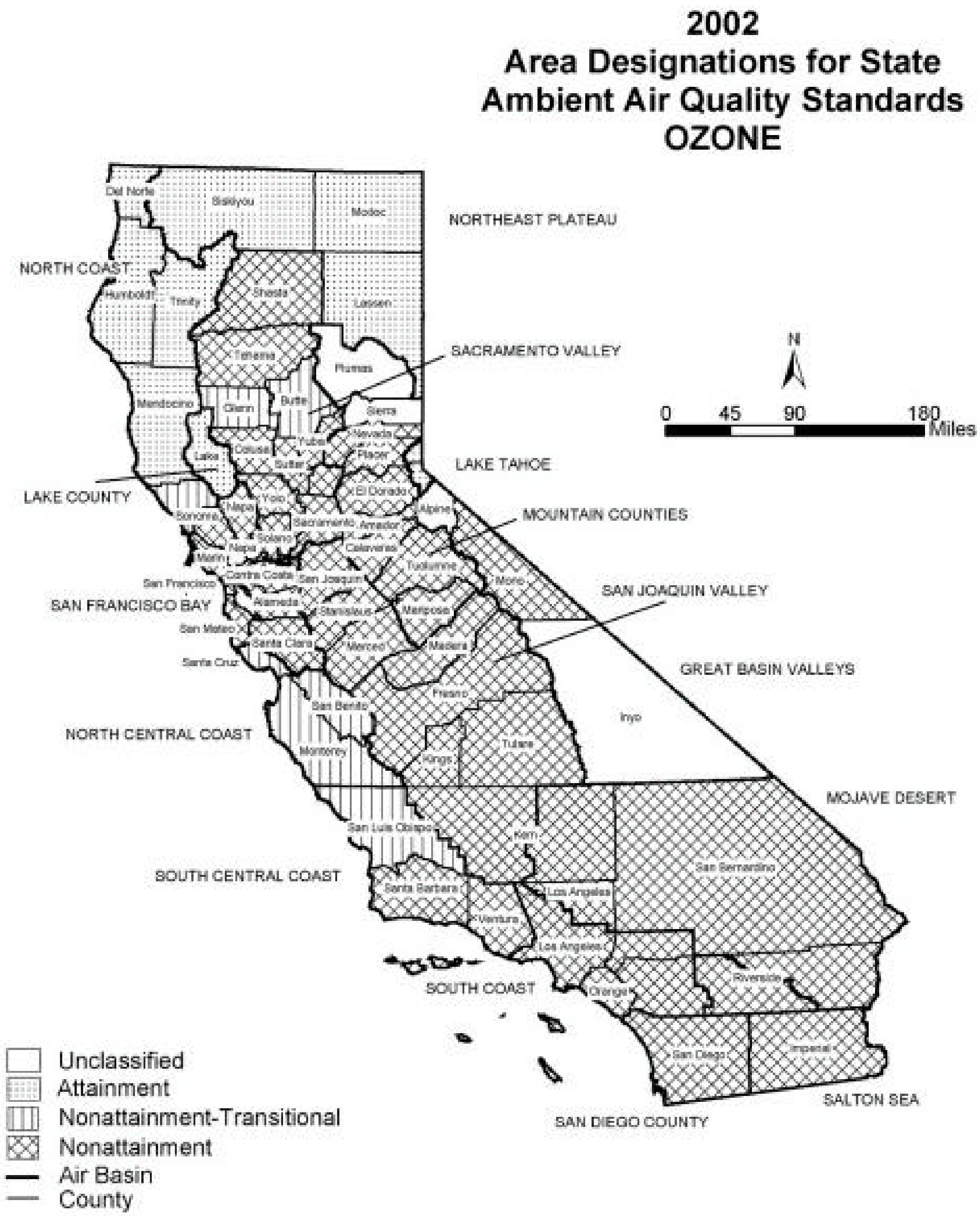


Figure IV-4
Area Designations for State Ambient Air Quality Standard for PM_{10}

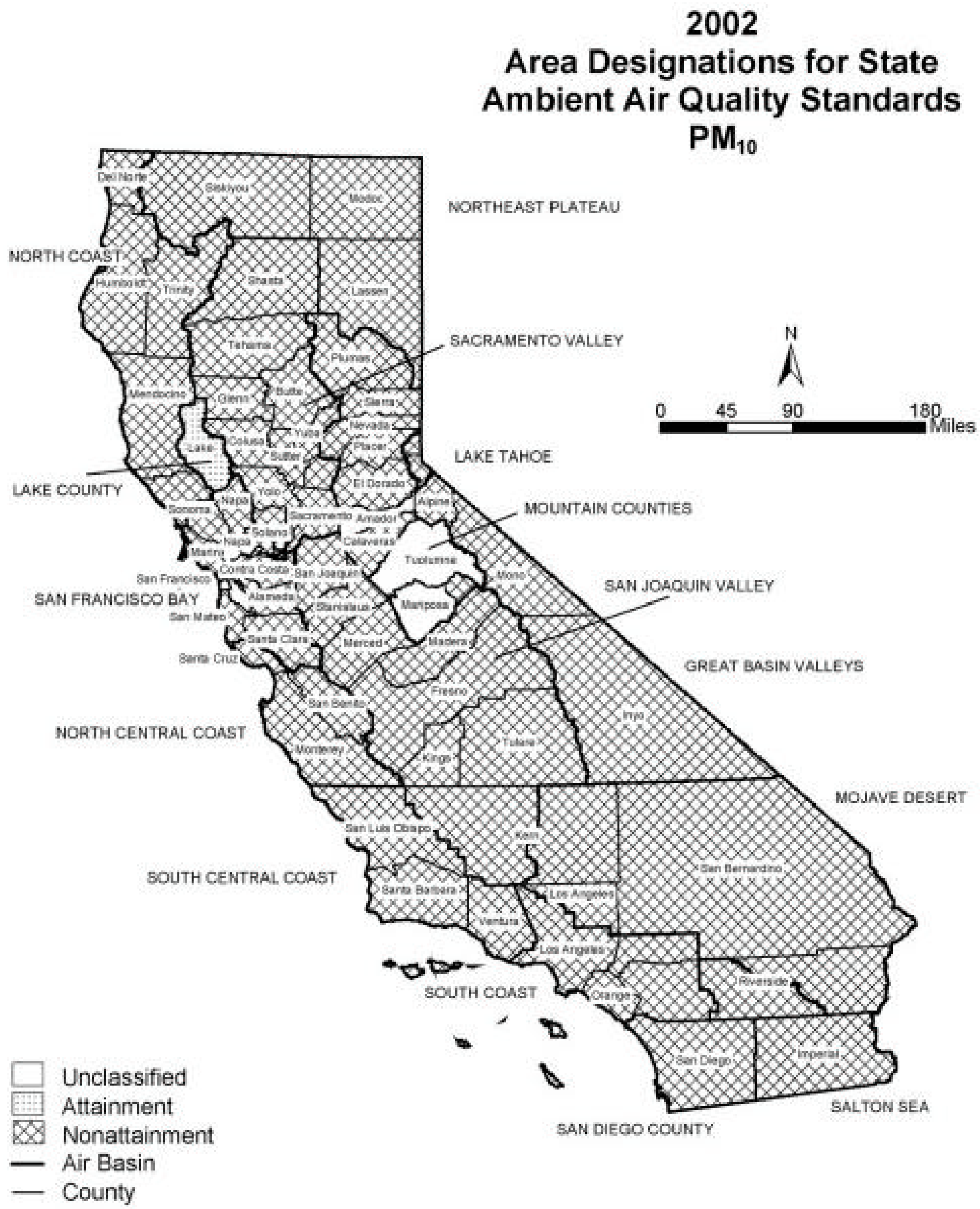


Figure IV-5
Area Designations for National Ambient Air Quality Standard for Ozone

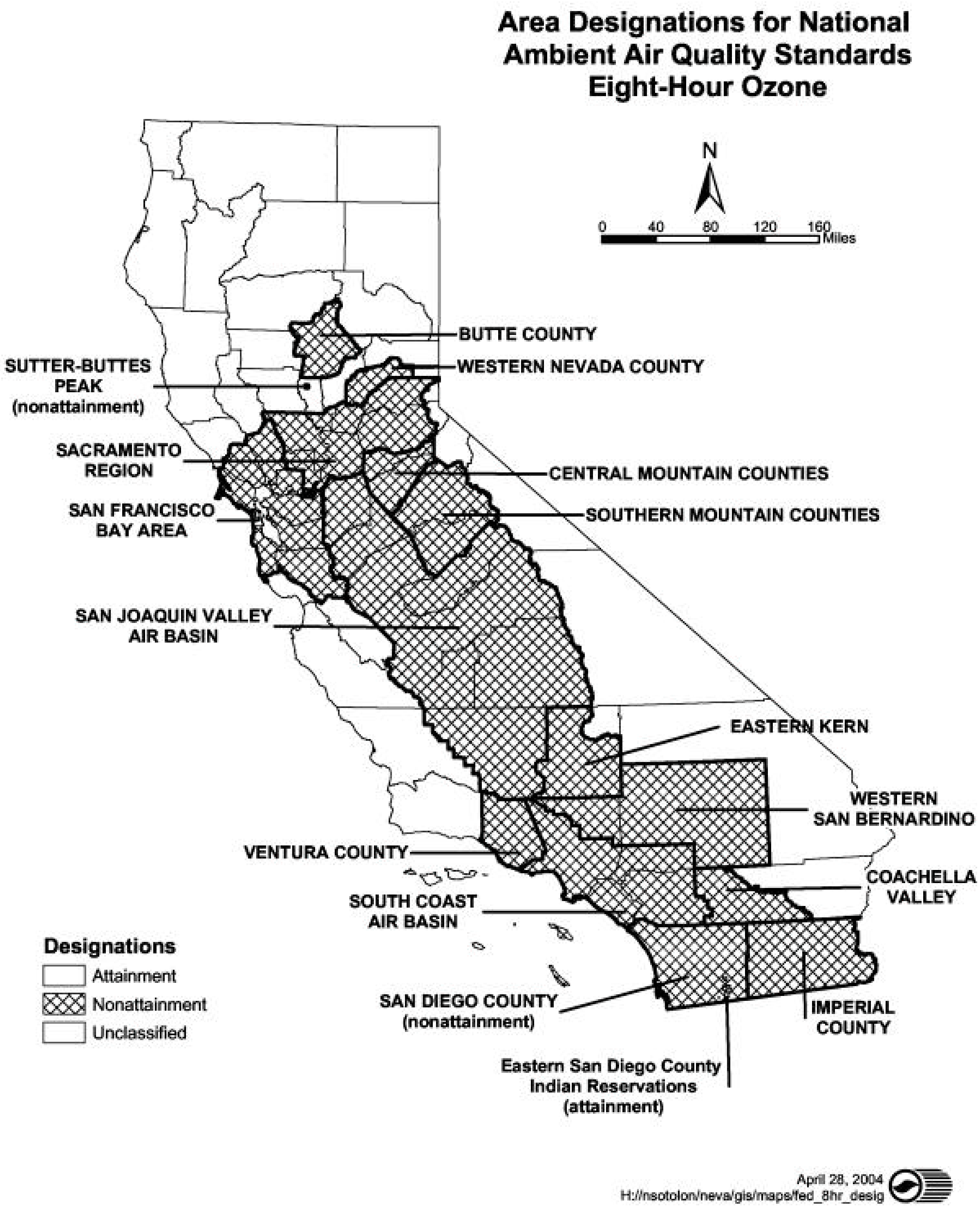
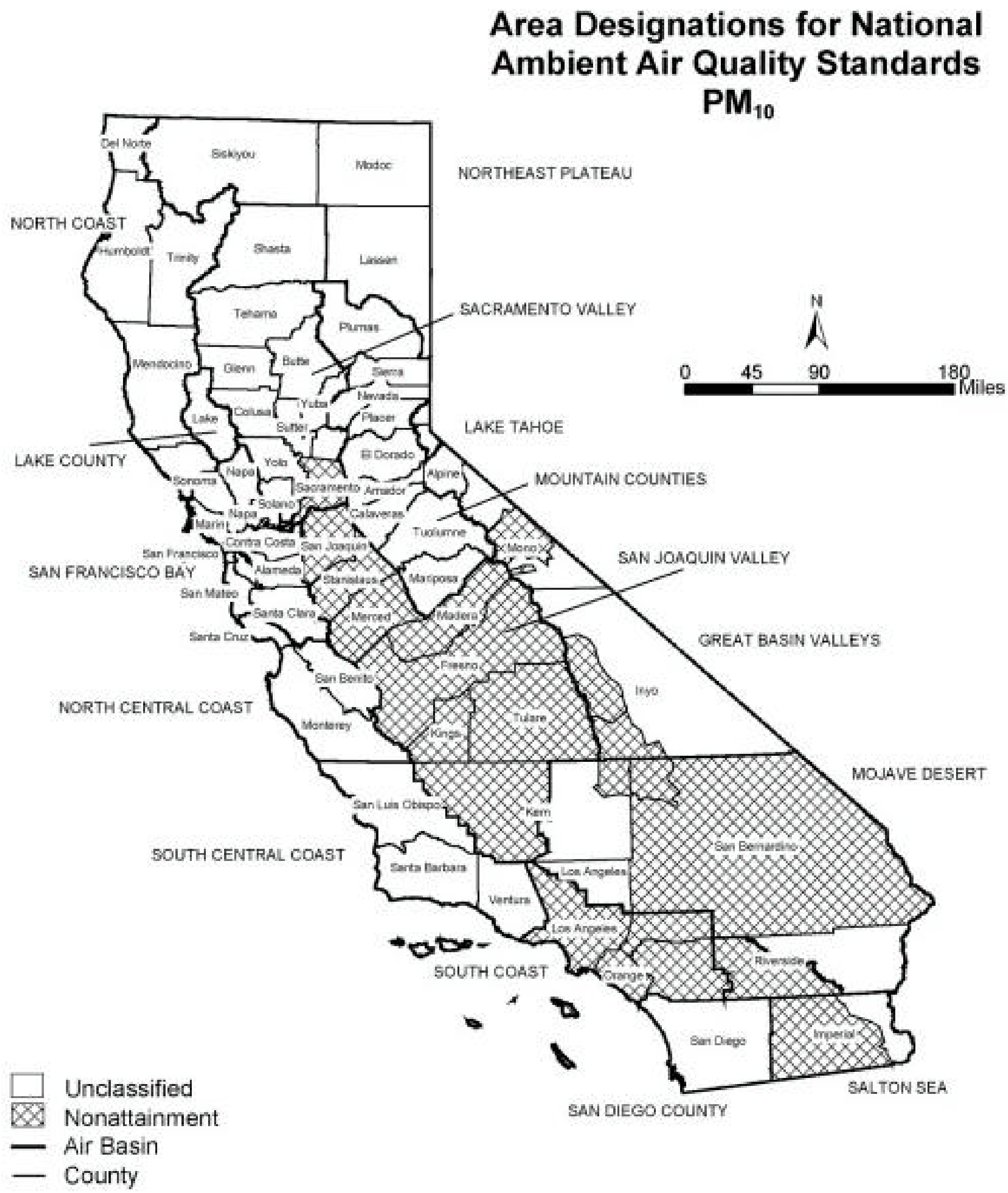


Figure IV-6
Area Designations for National Ambient Air Quality Standard for PM_{10}



B. WHY REGULATE CONSUMER PRODUCTS?

A consumer product is defined as a chemically formulated product used by household and institutional consumers. Consumer products include, but are not limited to: detergents; cleaning compounds; polishes; floor finishes; cosmetics; personal care products such as antiperspirants and hairsprays; home, lawn, and garden products; disinfectants; sanitizers; automotive specialty products; and aerosol paints. Other paint products, such as furniture or architectural coatings, are not part of ARB's consumer products program because local air districts regulate them.

Consumer products are a significant source of VOC emissions in California and contribute to the formation of both ozone and particulate matter pollution. Although each consumer product may seem to be a small source of emissions, the cumulative use of these products by over 35 million Californians results in significant emissions. Consumer products accounted for approximately 267 tons per day (tpd) of VOC emissions in the year 2000, which comprised about eight percent of the total man-made VOC emissions statewide. Volatile organic compound emissions from consumer products lead to the formation of ozone and are a significant source of air pollution in California. Further reductions in VOC emissions from consumer products and other VOC sources are needed if ozone standards are to be achieved.

As a result of several regulations adopted by the ARB over the last fifteen plus years, emissions from consumer products and aerosol coatings have decreased, and continued reductions are projected through 2005. As a result of these measures, statewide consumer product emissions have been reduced by over 130 tpd ROG (40 percent reduction) in 2005. Due to population growth, and without additional controls, staff expects the trend of emissions reductions to reverse once the last of the already adopted standards takes effect in 2005.

Over the past 25 years, air pollution agencies in California have been working diligently to improve air quality. Much of the effort was directed to the more traditional sources of air pollution such as mobile sources (e.g., cars, trucks, etc.) and stationary sources (e.g., factories, power plants, etc.). There have been dramatic gains in reducing emissions from these traditional sources. However, to continue to make progress toward meeting the state and federal ambient air quality standards and protecting the public health of California citizens, there is a need for further reductions from other sources of emissions including consumer products. Also, as emissions from the traditional sources are further reduced, emissions from all other sources, including consumer products, have become more significant. Therefore, the emissions from these sources must be evaluated for possible reductions.

Air shed modeling conducted during development of California SIPs has shown that VOC emission reductions lead to reduced ozone in metropolitan areas. Depending on the area, NO_x emission reductions can lead to reductions or increases in peak ozone concentrations. Due to low VOC to NO_x ambient ratios in the South Coast Air Basin (SoCAB), NO_x emission reductions lead to increases in the basin peak ozone concentration on episodic days. However, NO_x emission reductions are necessary to reduce secondary PM nitrate concentrations. During the SIP development modeling process, the NO_x emission target is identified during the PM planning phase. A series of emission reduction simulations are made to estimate a “target” carrying capacity for VOC for the given basin NO_x emission level. Many control measures are needed to reduce both VOC and NO_x emissions to the desired target levels. This VOC – NO_x interaction is discussed further in the “Final Program Environmental Impact Report, Suggested Control Measure for Architectural Coatings,” June 2000 (ARB, 2000a).

Previous modeling studies for the South Coast Air Basin have shown that consumer product VOC emission reductions reduce both ozone peak concentrations and population exposure to ozone (ARB, 1996). Therefore, consumer products control measures represent an important part of the VOC reductions needed to achieve the ozone standards.

Recognizing the importance of the potential impact of VOC emissions from consumer products, the California Legislature enacted the California Clean Air Act of 1988 (the Act). The Act declared that attainment of the California state ambient air quality standards is necessary to promote and protect public health, particularly the health of children, older people, and those with respiratory diseases. The Act added section 41712 to the California Health and Safety Code (HSC), which requires the ARB to adopt regulations to achieve the maximum feasible reduction in VOCs emitted by consumer products. As part of the regulatory process, the ARB must determine that adequate data exist to adopt the regulations. The ARB must also determine that the regulations are technologically and commercially feasible, necessary, and do not eliminate any product form. To date, VOC standards for 83 categories of consumer products (including antiperspirants and deodorants and aerosol coatings (36 categories)) have been established to meet the requirements of the Act.

The regulations adopted to date will achieve a 40 percent reduction in VOC emissions from consumer products by the year 2005. Since significant further VOC reductions are necessary to attain the federal ozone standard, the reductions from the 2004 Amendments proposed in this report are therefore “necessary” within the meaning of section 41712 of the HSC. In addition, section 41712(b)(1) of the HSC provides that a regulation’s “necessity” is to be evaluated in terms of both the state and federal standards. The 2003 Ozone SIP only addresses the ARB’s commitments to achieve the federal 1-hour air quality standard for ozone. The state ozone standard is more stringent than the federal 1-hour standard, and will require even greater emission reductions to achieve attainment.

The applicable state and federal laws show that both the U.S. Congress and the California Legislature intended progress toward clean air to be made as quickly as possible. The Act specifically declares that it is the intent of the Legislature that the state air quality standards be achieved “...by the earliest practicable date...” (see HSC, sections 40910 and 40913(a); see also the uncodified section 1(b)(2) of the Act (Stats. 1988, Chapter 1568)). A similar intent is expressed in the federal Clean Air Act, which declares that the federal air quality standards are to be achieved "...as expeditiously as practicable..." (see sections 172(a)(2), 181(a), and 188(c) of the federal Clean Air Act). For all of the reasons described above, the proposed amendments are "necessary" within the meaning of HSC section 41712.

On November 15, 1994, ARB adopted the California State Implementation Plan for Ozone (SIP). The SIP serves as California's overall plan for attaining the federal ambient air quality standard for ozone. Achieving significant VOC reductions from consumer products is a key element of the SIP. The consumer products element of the SIP is comprised of Near-term, Mid-term, and Long-term measures. The Near-term measures are comprised of the Phase I and II consumer products regulations (and other ARB regulations related to consumer products). The Mid-term measures commitment was partially fulfilled by the Phase III and Mid-term Measures II amendments to the Consumer Products Regulation.

In 1997, three environmental groups (Communities for a Better Environment, the Coalition for Clean Air, and the Natural Resources Defense Council) filed a complaint in the United States District Court for the Central District of California. The lawsuit was filed against ARB, the South Coast Air Quality Management District, and the United States Environmental Protection Agency (U.S. EPA) related to California's progress in achieving the 1994 SIP commitments. In January 1999, the ARB and these groups reached a settlement agreement, which was amended in December 1999 and June 2003 (U.S. District Court, Central District of CA, Case No. CV-97-6916 JSL (SHx)). Although the SIP was revised in October 2003 (discussed below) to replace the State's original commitments under the 1994 SIP for the South Coast, the settlement agreement will remain in place until ARB fulfills its obligations under the agreement.

The settlement agreement includes a list of measures to be considered by the ARB and a schedule. Included in the list of specific measures, the ARB staff committed to propose to the Board by June 30, 2004, a control measure for a 2 tons per day VOC emission reduction in the South Coast Air Basin, if feasible. The implementation period for the control measure is 2006. The amendments to the Consumer Products Regulation proposed in this staff report are intended to fulfill this commitment and to partially fulfill the remaining VOC reduction commitment in the settlement agreement.

On October 23, 2003, ARB adopted *the Proposed 2003 State and Federal Strategy for the California State Implementation Plan* (Statewide Strategy) which reaffirms ARB's commitment to achieve the health-based air quality standards through specific near-term actions and the development of additional longer-term strategies. The Statewide Strategy identifies the Board's near-term regulatory agenda to reduce ozone and particulate matter by establishing enforceable targets to develop and adopt new measures for each year from 2003 to 2006, including commitments for the Board to consider 19 specific measures. It also sets into motion a concurrent initiative to identify longer-term solutions to achieve the full scope of emission reductions needed to meet federal air quality standards in the South Coast and San Joaquin Valley by 2010. In addition to meeting federal requirements, this Strategy ensures continued progress towards California's own health-based standards.

In the 2003 State Strategy, ARB committed to two primary measures specific to consumer products and future reductions:

- **Measure CONS-1: Set New Consumer Products Limits for 2006.** The ARB has committed to develop a measure to be proposed to the Board by 2004 and implemented by 2006 that would reduce VOC emissions from consumer products by at least 5.3 tpd statewide in 2010.

- **Measure CONS-2: Set New Consumer Products Limits for 2008-2010.** The ARB has committed to develop new consumer product category limits to be proposed to the Board in 2006 and 2008, with implementation in 2008 and 2010, that would reduce VOC emissions from consumer products by 20-35 tpd statewide in 2010.

- **Further Reductions from Consumer Products.** In addition, it is expected that further emission reductions will be needed from all source categories, including consumer products, to meet the long-term emission reduction targets included in the South Coast SIP.

The 2004 Amendments proposed in this staff report are intended to fulfill the commitment for SIP measure CONS-1.

ARB and local air districts are in the process of updating the California SIP to show how each region in the state will meet the federal air quality standards. The measures outlined in the adopted Statewide Strategy are being incorporated into these SIP revisions. The South Coast's 2003 Air Quality Management Plan was adopted by the South Coast Air Quality Management District Governing Board on August 1, 2003. ARB approved the local SIP element on October 23, 2003, and on January 9, 2004, ARB submitted to the U.S. EPA both the Statewide Strategy and the 2003 South Coast SIP as revisions to the California SIP. The new SIP updates all elements of the approved 1994 SIP and includes additional consumer products measures. Upon approval by U.S. EPA, the 2003 SIP will replace the State's commitments in the 1994 SIP. ARB is currently working with the San Joaquin Valley Unified Air Pollution Control District on a revision to the San Joaquin Valley's ozone SIP. The revised San Joaquin Valley SIP is scheduled for consideration by the District's Governing Board and by ARB later this year.

C. ESTIMATED EMISSIONS FROM CATEGORIES PROPOSED TO BE REGULATED IN 2004 CONSUMER PRODUCTS REGULATION AMENDMENTS

2001 Consumer and Commercial Products Survey

The 2001 Consumer and Commercial Products Survey (2001 Survey) was mailed to over 3,000 companies in September 2002 (Appendix D). The 2001 survey requested data on 48 categories of consumer products. Extensive outreach efforts were made to maximize the market coverage of the 2001 Survey. First, we performed numerous shelf surveys, conducted trade journal and Internet searches and scrutinized results from previous surveys to identify manufacturers and add them to our mailing list. Following the Survey, shelf surveys were again performed, and the list of responding companies was scrutinized by trade associations and survey respondents to identify additional companies which had not responded. Companies that did not initially respond to the survey were contacted, requested to submit the required information, and subsequently, many additional surveys were submitted. The extensive outreach resulted in an estimated 85 to 90 percent market coverage in most categories.

The Survey requested detailed information on the formulations of consumer products, including complete speciation of VOC's, low vapor pressure VOC (LVP-VOC) solvents, and key exempt ingredients, as well as total volumes of inorganic and exempt compounds. Information on sales, product form, customer types, and company size and economics were also requested. Due to the complexity of the data, staff thoroughly reviewed incoming surveys to ensure accuracy prior to entry in the database. When inconsistencies were found, we contacted the survey respondents and made the necessary corrections. Many corrections were made to formulation data to appropriately classify compounds as VOC's, LVP-VOCs, exempt compounds, or inorganic compounds. Prior to entry into the consumer products database, we made every effort to verify and correct the Survey data.

To further ensure the accuracy of the Survey data, we provided extensive summaries to industry detailing the aggregate sales, VOC speciation, VOC tonnage, and other key information. Summary tables were also provided (certain specific data was omitted to protect confidential information), detailing VOC content, product form, LVP-VOC content, and other information. The results of the Survey were discussed at workgroup meetings, and input from industry was used to correct inaccuracies in the data.

To minimize the burden to industry, we developed software to allow manufacturers to submit their surveys electronically. The software aided many manufacturers in reporting large numbers of products and also performed certain data checks automatically. We also developed software to automate calculations of emissions, emission reductions, market coverage and other frequently performed calculations.

Over 400 companies had responded to the Survey by July 2003, reporting over 7,000 products sold in California. The 2001 VOC emissions from the consumer product categories surveyed are estimated to be about 40 tons per day, representing an estimated 15 percent of the total consumer products inventory, on an emissions basis. The focus of the 2001 Survey was primarily on categories that had not previously been regulated and where opportunities for emission reductions were identified. In addition, several categories were surveyed primarily for the purpose of improving the emission inventory or to gain a better understanding of a general category of products. The categories surveyed were widely varied and included products from all general areas of consumer products, however, there was a specific detailed focus on hair care products and solvents. The total VOC emissions from the categories initially proposed for regulation comprised approximately 10.6 tpd statewide in 2001. The information gathered in the 2001 Survey will be used to update the 2001 Air Resources Board emission inventory where appropriate.

Market Coverage Adjustments to the Survey

It is not possible for a survey of this magnitude to reach the entirety of the consumer products industry. Therefore, staff performed shelf surveys to determine the appropriate market coverage adjustment for each category proposed for regulation. Adjustments were made based upon the number of products found on store shelves that were not reported in the Survey. Generally, we found about 8 or 9 out of every 10 products had been reported. Hence, for most categories, the market coverage was estimated to be about 85 to 90 percent.

Some market sectors have historically had a low response rate in previous surveys. For example, in the 1997 Survey effort, it was discovered that automotive windshield washer fluids are frequently produced by small companies which move in and out of the market, so tracking these companies and maintaining a complete mailing list is difficult. For categories where the coverage was determined to be low, adjustments were made by a variety of methods, including previous survey data, bar code data, estimates from industry publications, etc. This additional adjustment was made in only 1 of the 15 categories proposed for regulation.

Adjustments to the inventory to account for the incomplete market coverage inherent in the survey process is not without precedent. The U.S. EPA, in compiling their emissions estimates for their 1990 survey, increased the sales in most categories to account for incomplete market coverage. In addition, the 1994/1995 Mid-term Measures Survey, and the 1997 Survey results were also adjusted. Staff worked with industry members during the development of the 2004 Regulation Amendments to determine the survey coverage, and made adjustments to initially proposed market coverage factors.

Emission Estimates for Categories

The total emissions from the 15 categories proposed for regulation in the 2001 Regulation Amendments is estimated to be 8.5 tons per day in 2001. Table IV-2 summarizes these emissions.

Table IV-2
VOC Emissions by Product Category

Product Category	Product Form	2001 VOC Emissions Adjusted (Tons/Day)
Adhesive Removers:		
Gasket or Thread Locking Adhesive Removers	All	0.031
General Purpose Adhesive Remover	All	0.304
Specialty Adhesive Remover	All	0.460
Floor or Wall Covering Adhesive Remover	All	0.666
Anti-Static Product	Aerosol	0.275
	Non-aerosol	0.000
Contact Adhesive:		
Contact Adhesive-General Purpose	All	0.070
Contact Adhesive-Special Purpose	All	0.075
Electrical Cleaner	All	0.330
Electronic Cleaner	All	0.241
Fabric Refresher	Aerosol	0.424
	Non-Aerosol	0.665
Footware or Leather Care Product	Aerosol	0.050
	Solid	0.174
	All Other Forms	0.094
Graffiti Remover	Aerosol	0.085
	Non-aerosol	0.11
Hair Styling Product	Aerosol*, Pump Spray	0.468
	All Other Forms	0.190
Shaving Gel	All	1.030
Toilet/Urinal Care Product	All Forms*	2.659
Wood Cleaner	Aerosol	0.053
	Non-aerosol	0.226

* To protect confidentiality, emissions have been grouped

Adequate Data

With our estimate of 85-90 percent market coverage for most categories, we feel confident that the Survey had adequate representation of the available technologies in the market place. This assumption has been verified by discussions with manufacturers, category research and the wide range of VOC content reported for products in the categories slated for regulation. Historically for many product categories, the market sector with the lowest coverage is the "private label" sector. The private label market sector does not manufacture products. They purchase products from manufacturers, then put their own brand name on them. Those products generally employ the same technologies as other products made by manufacturers. However, staff believes that because the 2001 Survey had good response from the primary manufacturers, that the survey contained adequate information on most if not all technologies available in the marketplace.

Staff has worked extensively with industry representatives on each category proposed for regulation. In meetings with members of industry, extensive discussions on the types of technologies used in each category were discussed. Numerous product labels and associated literature for each category were analyzed. Category information was also obtained from trade journals, Internet sites, textbooks, and directly from manufacturers.

REFERENCES

Air Resources Board, Staff Report. Effect of Ozone on Vegetation and Possible Alternative Ambient Air Quality Standards. March, 1987. (ARB, 1987)

Air Resources Board, Memorandum. National Exposure to Ozone. From Terry McGuire to Michael H. Scheible. January 6, 1994. (ARB, 1994)

Air Resources Board. Consumer Products Working Group Meeting: A Brief Overview of Photochemical Grid Modeling. October 1996. (ARB, 1996)

Air Resources Board. Letter to Ms. Mary Nichols, United States Environmental Protection Agency. ARB Comments on U.S. EPA Proposals for New, National Clean Air Goals and Policies. March 11, 1997. (ARB, 1997)

Air Resources Board. Final Program Environmental Impact Report Suggested Control Measure for Architectural Coatings, June 2000. (ARB, 2000a)

Air Resources Board and Office of Environmental Health Hazard Assessment. Adequacy of California Ambient Air Quality Standards: Children's Environmental Health Protection Act. December 22, 2000, available at http://www.arb.ca.gov/research/aaqs/caaqs/ad-aaqs/ad-aaqs.htm (ARB, 2000b)

Air Resources Board and Office of Environmental Health Hazard Assessment. Staff Report: Public Hearing to Consider Amendments to the Ambient Air Quality Standards for Particulate Matter and Sulfates, available at http://www.arb.ca.gov/research/aaqs/std-rs/pm-final/pm-final.htm. (ARB, 2002a)

Air Resources Board. 2002 Area Designations and Maps. December 2002, available at http://www.arb.ca.gov/desig/desig02/desig02.htm. (ARB, 2002b)

Air Resources Board. The 2003 California Almanac of Emissions and Air Quality, available at http://www.arb.ca.gov/aqd/almanac/almanac03/toc03.htm. (ARB, 2003),

Atkinson, R. and J. Arey. Atmospheric Chemistry of Gas-phase Polycyclic Aromatic Hydrocarbons: Formation of Atmospheric Mutagens. Environmental Health Perspectives, 102 (Supplement 4), 117-126. (Atkinson and Arey, 1994)

Avol, E.L., W.J. Gauderman, S.M. Tan, S.J. London, and J.M. Peters. Respiratory effects of relocating to areas of differing air pollution levels. Am J Respir Crit Care Med, 164: 2067-2072. (Avol *et al.,* 2001)

Bowman, F.M., Pilinis, C. and Seinfeld, J.H. Ozone and aerosol productivity of reactive organics. Atmospheric Environment, 29, 579-589. (Bowman *et al.,* 1995)

Carter, W.P.L. Documentation of the SAPRC-99 Chemical Mechanism for VOC Reactivity Assessment. Final report to California Air Resources Board, Contract No. 92-329 and No. 95-308. (Carter, 2000)

Finlayson-Pitts, B.J. and J.N. Pitts Jr. Chemistry of the Upper and Lower Atmosphere Chapter 9, Academic Press, New York. (Finlayson-Pitts and Pitts, 2000)

Gauderman, W.J., R. McConnell, F. Gilliland, S. London, D. Thomas, E. Avol, H. Vora, K. Berhane, E.B. Rappaport, F. Lurmann, H.G. Margolis, and J. Peters. Association between Air Pollution and Lung Function Growth in Southern California Children. Am J Respir Crit Care Med, Vol 162, 1383-1390. (Gauderman *et al.,* 2000)

Gauderman, W.J., G.F. Gilliland, H. Vora, E. Avol, D. Stram, R. McConnell, D. Thomas, F. Lurmann, H.G. Margolis, E.B. Rappaport, K. Berhane, and J.M. Peters. Association between Air Pollution and Lung Function Growth in Southern California Children: Results from a second cohort. Am J Respir Crit Care Med, 166: 76-84. (Gauderman *et al.,* 2002)

Gilliland, F.D., K. Berhane, E.B. Rappaport, D.C. Thomas, E. Avol, W.J. Gauderman, S.J. London, H.G. Margolis, R. McConnell, K. Talat Islam, and J.M. Peters. The Effects of Ambient Air Pollution on School Absenteeism Due to Respiratory Illness. Epidemiology, January 2001, Vol 12, No.1, 43-54. (Gilliland *et al.,* 2000)

Godish, Thad. Air Quality. Lewis Publishers, Inc., Chelsea, Michigan, 1991. (Godish, 1991)

Griffin, R.J., Cocker III, D.R., and Seinfeld, J.H. Incremental aerosol reactivity: application to aromatic and biogenic hydrocarbons. Enviorn. Sci. Technol., 33, 2403-2408. (Griffin *et al.,* 1999)

Grosjean, D. *In situ* organic aerosol formation during a smog episode: estimated production and chemical functionality. Atmospheric Environment, 26A, 953-963. (Grosjean, 1992)

Grosjean, D. and J.H. Seinfeld. Parameterization of the Formation Potential of Secondary Organic Aerosols. Atmospheric Environment, 23, 1733-1747. (Grosjean and Seinfeld, 1989)

Harner, T. and Bidleman, T.F. Octanol-air partition coefficient for describing particle/gas partitioning of aromatic compounds in urban air. Environ. Sci. Technol., 32, 1494-1502. (Harner and Bidleman, 1998)

Kleindienst, T.E., Smith, D.F., Li, W., Edney, E.O., Driscoll, D.J., Speer, R.E., and Weathers, W.S. Secondary organic aerosol formation from the oxidation of aromatic hydrocarbons in the presence of dry submicron ammonium sulfate aerosol. Atmos. Enviorn., 33, 3669-3681. (Kleindienst *et al.,* 1999)

McConnell, R., K. Berhane, F. Gilliland, S.J. London, T. Islam, W.J. Gauderman, E. Avol, H.G. Margolis, and J.M. Peters. Asthma in exercising children exposed to ozone: A cohort Study. Lancet, 359:386-391. (McConnell *et al.,* 2002)

McConnell, R., K. Berhane, F.Gilliland, J. Molitor, D. Thomas, F. Lurmann, E. Avol, W.J. Gauderman, and J.M. Peters. Prospective study of air pollution and bronchitic symptoms in children with asthma. Am J Respir Crit Care Med, Vol 168, 790-797 (McConnell *et al.,* 2003)

Moolgavkar, S.H. and Luebeck, E.G. A critical review of the evidence on particulate air pollution and mortality. Epidemiology, 7, 420-428. (Moolgavkar and Leubeck, 1996)

Odum, J.R., T. Hoffmann, F. Bowman, D. Collins, R.C. Flagan, and J.H. Seinfeld. Gas/Particle Partitioning and Secondary Organic Aerosol Yields. *Environmental Science & Technology*, 30, 2580-2585. (Odum *et al.,* 1996)

Odum, J.R., T.W.P. Jungkamp, R.J. Griffin, H.J.L. Forstner, R.C. Flagan, and J.H. Seinfeld. Aromatics, Reformulated Gasoline, and Atmospheric Organic Aerosol Formation. *Environmental Science & Technology,* 31, 1890-1897. (Odum *et al.,* 1997)

Pandis, S.N., R.A. Harley, G.R. Cass, and J.H. Seinfeld. Secondary Organic Aerosol Formation and Transport. Atmospheric Environment, 26A, 2269-2282. (Pandis *et al.,* 1992)

Pankow, J.F. An absorption model of gas/particle partitioning of organic compounds in the atmosphere. Atmospheric Environment, 28, 185-188. (Pankow, 1994a)

Pankow, J.F. An absorption model of the gas/aerosol partitioning involved in the formation of secondary organic aerosol. Atmospheric Environment, 28, 189-193. (Pankow, 1994b)

Peters, J.M., E. Avol, W.J. Gauderman, W.S. Linn, W. Navidi, S.J. London, H. Margolis, E. Rappaport, H. Vora, H. Gong, Jr., and D.C. Thomas. A study of twelve southern California communities with differing levels and types of air pollution. II. Effects on pulmonary function. Am J Respir Crit Care Med, Vol 159: 768-775. (Peters *et al.,* 1999)

Schwartz, J., Dockery, D.W., and Neas, L.M. Is daily mortality associated specifically with fine particles. J. Air Waste Manage. Assoc., 46, 927-939. (Schwartz *et al.,* 1996)

Seinfeld, John H., and Pandis, Spyros N. Atmospheric Chemistry and Physics-From Air Pollution to Climate Change. John Wiley & Sons, New York, 1998. (Seinfeld and Pandis, 1998)

Senate Bill 25, Escutia, Stats. 1999, Ch 731 (Senate Bill 25, Escutia, 1999)

Settlement Agreement, with amendments, in *Coalition for Clean Air, Inc. et al. v. South Coast Air Quality Management District, et al*. (U.S. District Court, Central District of CA, Case No. CV-97-6916 JSL (SHx))

Turpin, B.J. and Huntzicker, J.J. Secondary formation of organic aerosol in the Los Angeles basin: a descriptive analysis of organic and elemental carbon concentrations. Atmospheric Environment, 25A, 207-215. (Turpin and Huntzicker, 1991)

Turpin, B.J. and Huntzicker, J.J. Identification of secondary organic aerosol episodes and quantitation of primary and secondary organic aerosol concentrations during SCAQS. Atmospheric Environment, 29, 3527-3544. (Turpin and Huntzicker,1995)

United States Environmental Protection Agency. Air Quality Criteria for Ozone and Related Photochemical Oxidants. July, 1996, Volume I and III. (U.S. EPA, 1996)

United States Environmental Protection Agency. National Ambient Air Quality Standards for Particulate Matter; Final Rule. Federal Register. July 18, 1997, Volume 62, Number 138, available at http://www.epa.gov/ttncaaa1/t1/fr_notices/pmnaaqs.pdf (U.S. EPA, 1997)

United States Environmental Protection Agency. Final Rule to Implement the 8-Hour Ozone National Ambient Air Quality Standard – Phase 1, Federal Register: 69 23951 (April 30, 2004), available at http://www.epa.gov/ozonedesignations/finalrule.pdf (U.S. EPA, 2004a)

United States Environmental Protection Agency. Air Quality Designations and Classifications for the 8-Hour Ozone National Ambient Air Quality Standards; Early Action Compact Areas with Deferred Effective Dates. Federal Register: April 30, 2004, Volume 69, Number 84, Rules and Regulations, Page 23857-23951, available at http://www.epa.gov/fedrgstr/EPA-AIR/2004/April/Day-30/a9152.htm (U.S. EPA, 2004b)

Wang, S.C., S.E. Paulson, D. Grosjean, R.C. Flagan, and J.H. Seinfeld. Aerosol Formation and Growth in Atmospheric Organic/NO_x Systems-I. Outdoor Smog Chamber Studies of C_7- and C_8-Hydrocabrons. Atmospheric Environment, 26A, 403-420. (Wang *et al.,* 1992)

Yu J., Cocker III, D.R., Griffin, R.J., Flagan, R.C., and Seinfeld, J.H. Gas-Phase Ozone Oxidation of Monoterpenes: Gaseous and Particulate Products. J. Atmos. Chem., 34, 207-258. (Yu *et al.,* 1999)