

ACHIEVING AIR QUALITY: THE LOS ANGELES EXPERIENCE

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ACHIEVING AIR QUALITY: THE LOS ANGELES EXPERIENCE

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Executive Summary

During the past thirty-five years of economic development, population growth and urban expansion, the Los Angeles region of California, USA, has appreciably reduced its level of air pollution. It has moved a long ways toward meeting the rigorous overall ambient air quality goals set by the State of California and the United States Clean Air Act, despite the fact that it remains the most severe nonattainment metropolitan region in the nation according to the U.S. Environmental Protection Agency (EPA). Los Angeles is a leading example of the importance of the metropolitan-based approach to emissions reduction being pursued in the United States today, albeit nested in a broader state and federal government policy. Key political, economic, cultural, and technological factors have combined to bring about significant reduction in air pollution in Los Angeles. The subject of this report is nature of these factors and how they have evolved, and the continuing challenges to improving the region's air quality.

Playing an important role over the past thirty-five years has been the significant improvements in stationary and mobile air emissions control technology and business practices; the development of demanding clean air policy at the national, state, and regional level; and, the creation of a strong regional administrative agency with the task of monitoring and implementing clean air policy. Little progress in cleaning the region's air would have occurred absent the unrelenting pressure by the public to do so. Pressure from the public has persisted through the highs and lows of the region's economic cycle. It persisted, also, through the philosophical and political shift in the United States that occurred in the 1980s and 1990s away from placing trust in the government's use of command-and-control policies to accomplish public policy goals, to the utilization of incentives and market-based strategies.

The Los Angeles region remains under substantial pressure from national, state, and local policy, and from the public, to achieve even further air emission reduction, especially with respect to today's prominent pollution "hot-spots". Meanwhile, the region's population continues to grow and the economy to thrive and expand, with all this implies for the generation of greater levels of overall mobile source air emissions. Policy makers are being asked to make the choices about how to further reduce emissions at a

time when there is little general support for strengthening the powers of governmental agencies or increasing taxes to address problems such as air pollution, or for substantially altering the life style of the region's inhabitants. Thus, despite the impressive accomplishments in reversing the trends in air emissions and in meeting clean air goals in the region for more than thirty years, the struggle for better air quality is far from over.

Background: The Emergence of Clean Air Policy in the United States

Cleaning the air in the United States has been at or near the top of the public agenda throughout the past three and a half decades. The most important piece of public policy in this effort has been the adoption of the national Clean Air Act of 1970, through which Congress directed the newly established United States Environmental Protection Agency (EPA) to set national air quality standards to protect public health. These “National Ambient Air Quality Standards” were set for six criteria pollutants – *carbon monoxide, particulate matter, nitrogen oxide, ozone, nitrogen dioxide, and sulfur dioxide*. Lead was later added to the list as was small particulates, then even smaller ‘fine’ particulates and toxics emissions.

Implementing air pollution controls for all the nation’s industry and business as well as for mobile sources was not going to be easy under the best of circumstances. This fact, combined with the choir of complaints that arose from state and local governments, business, and industry over EPA’s top-down, command-and-control implementation style, in 1977 led Congress to amend the Clean Air Act. Rather than retain all power—and responsibility for performance and public accountability—in the central government, Congress shifted to the states and many local and regional control agencies important responsibilities for the Act’s implementation (Kamieniecki and Ferrall 1991; Bryner 1993). This was a significant turning point in the implementation of air pollution control policy in the United States. How this strategy has unfolded in one case, in the Los Angeles region of California, is the focus of this report. But first a brief overview of the

overall trends in air emissions reductions under the Clean Air Act is presented.

Performance under the U.S. Clean Air Act of 1970

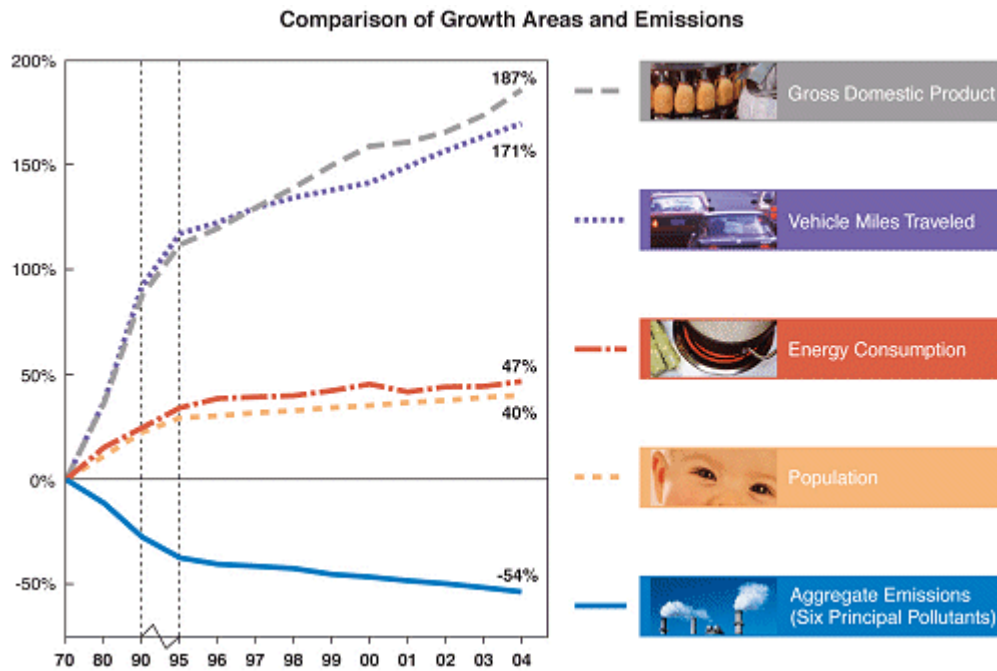
Looking back over the past three and a half decades, it is reasonable to argue that the combined federal-state-local government regulatory approach has been very success. For the nation as a whole, lead emissions have shrunk by 98%, largely due the government’s mandating of lead-free gasoline. Emissions of small particulates from industry and fuel combustion have declined by nearly 80%, sulfur dioxide by 40%, carbon dioxide by 28%, and ozone by 35%. Based on the 2003 EPA study “Benefits and Costs of the Clean Air Act,” the most comprehensive assessment to date of both the benefits and costs of US air pollution policy between 1970-1990, the benefits to health and the environment have significantly outweighed the costs, by a ratio of 42 to one.

From 1970-2004, the Gross Domestic Product (GDP) of the United States increased by 187 percent, the vehicle miles traveled increased by 171 percent, energy consumption by 47 percent, and the nation’s population by 40 percent. During that same period, the total emissions of the six principal air pollutants regulated under the Clean Air Act fell by 54 percent (*see Figure 1*).

Within these general trends, enormous variation in levels of reduction and continuing emissions continues across the nation, reflecting differences in economic activity, size and scale of communities, emissions reduction efforts by state and local officials, weather patterns and topography, life-styles, and individual susceptibility to the adverse effects of air pollutants.

Moreover, while the link between emissions of certain pollutants and human exposure and health risk is not proven, EPA states that as recently as 2000, 120 million Americans were still living in “nonattainment areas;” county jurisdictions where one or more of the emission reduction criteria were not met (Bryner 2005). Thus, while the first three and a half decades of the struggle to reduce air emissions has been successful, further reduction is required in a number of communities across the United States.

Figure 1: US Trends in Air Pollution, Economic Growth, Energy, and Transportation



Source: EPA, “Air Emissions Trends – Continued Progress Through 2004,” <http://www.epa.gov/airtrends/conom-emissions.html>.

A Regional Approach to Air Emissions: The Case of Los Angeles

Prior to the 1960s, it was the responsibility of local governments in California to identify and take action on controlling air emissions in their community. Neither the state nor the federal government was involved. County officials in Los Angeles, in 1945, took the lead in addressing air

pollution by prohibiting factories from emitting “dark smoke”. This was followed in the early 1950s by prohibiting the burning of municipal garbage, first in county dumps throughout the county and then in people’s backyard incinerators, which had been a common practice. Yet, as scientists began to discover, the problem was more than smoke from homes and factories. It was the meteorological conditions of a balmy climate and of atmospheric inversions that trapped in the air tons of tiny particles, lead, sulfur dioxide, carbon monoxide, nitrogen oxides, and ozone being emitted by cars, trucks, buses, ships, planes, industrial smoke stacks, and the normal operations of business, which is then “cooked” by the sun into photochemical smog.

In these early years, “smog cops” were employed to track down smoke belching cars on the freeways of Los Angeles (a high-tech version of which is being introduced today through ‘remote sensing’ devices to detect gross emitting vehicles). Extensive permitting and facility inspections were eventually instituted by the county and violations were met with fines and civil penalties. Public education campaigns were conducted and some modest emission reduction incentives were provided.

Box 1: Facts about Los Angeles

- From 1950 to 2005, the population in the Los Angeles region has more than tripled, from 4.8 million to over 16 million people (while California had grown to a little more than 36 million); the current forecast is that the state will increase by another 10-12 million by 2025.
- The number of motor vehicles on the road has more than quadrupled from 2.3 to more than 10 million from the 1940s through 2005.

- The California economy is the 7th largest, compared against all nations of the world, and the Los Angeles region is ranked 9th or 10th. Until the early 1990s, the region was one of the major aerospace and defense centers of the nation, and remains central in textiles and clothing design, light manufacturing, film making, media, software and electronics, computing, and finance; through the combined ports of Los Angeles and Long Beach (which are adjacent), flows 40% of the nation's of containerized cargo.
- The region enjoys a mild climate year-round, with ocean breezes blowing in from West to East at an average five miles per hour; for all their air pollution problems, Los Angelinos continue to enjoy the sun, the beaches, and the mountainous surroundings.
- The South Coast Air Quality Management District (AQMD) covers some 12,000 square miles, essentially the Los Angeles basin—Los Angeles, San Bernardino, Riverside, and Orange counties—and has planning jurisdiction over the desert beyond. It is bounded by the Pacific Ocean on the West, the San Gabriel, San Bernardino, and San Jacinto Mountains to the North and East.
- The region remains the most severely polluted major urban air shed in the nation. It is the only region continuously classified by EPA as **EXTREME** in air pollution.

As it became evident that local initiatives were insufficient in combating the region's growing air pollution problem, in the 1960s the State of California stepped in and, despite strong opposition from the automotive

industry (of importance, an industry centered in Detroit Michigan, not in California), began to place air pollution restrictions on new automobiles sold in California (Dewey 1997). The state also demanded more aggressive anti-air pollution steps be taken by local governments within the Los Angeles basin. As the issue of air pollution grew in prominence throughout the nation and its roots in automotive emissions became widely known, Congress increased the role of the Federal Government, most forcefully in the form of the 1970 amendments to the Federal Clean Air Act. The cumulative effect on Los Angeles of the expansion in local, state, and Federal air regulation over the coming decades was an air pollution control regime greater in capacity, with more funding, and reach into business, communities, and the lives of individual citizens than could be found anywhere in the nation; for that matter, the world.

At the center of the pollution control program in Los Angeles is the South Coast Air Quality Management District (AQMD). AQMD was established in 1977 by the California legislature to manage, within a single public agency, with greater coordination and comprehensiveness than ever before, the quality of air in the 12,000 square miles of the four-county Los Angeles air basin; which includes the counties of Los Angeles, Ventura, Riverside, and San Bernardino. (AQMD succeeded the then single-county Los Angeles County Air Pollution Control District, which dated back to 1947). AQMD is governed by a part-time, appointed board of twelve. Members are appointed one each from the four counties, from cities in the basin, and one each by the Governor of California, Speaker of the California State Assembly, and State Senate Rules Committee.

**Box 2: Key public agencies in the implementation of
Clean Air Policy in Los Angeles**

AQMD: The South Coast Air Quality Management District was established by the state legislature in 1977, incorporating and expanding the functions of the 30-year-old Los Angeles County Air Pollution Control District and similar agencies in Orange, Riverside and San Bernardino counties.

ARB: The California Air Resources Board chiefly sets motor vehicle emissions standards. California's standards, the nation's toughest, have been copied by several states. The ARB also monitors AQMD's performance and must approve AQMD's clear air plans.

SCAG: The Southern California Association of Governments is a voluntary planning council composed of mayors, city council members and county supervisors from Los Angeles, Orange, Riverside, San Bernardino, Ventura and Imperial counties. Established in the mid-1960s, SCAG's strength is its research and economic and demographic forecasts. Its findings are incorporated into long-range regional plans dealing with transportation, air and water quality, housing needs and growth management. However, it has little power to implement its findings.

EPA: The U.S. Environmental Protection Agency, established in 1970 by Congress to address the nation's environmental problems, must approve the AQMD's clear air plan after it is reviewed and approved by the ARB. It has authority to impose additional controls on the basin if the regional plan falls short. EPA conducts research on the effects of pollution and assists the state and local environmental agencies.

The mission of AQMD is to protect public health from air pollution under the guidance of all relevant Federal, state, and regional air pollution laws and standards (*see Box 2*). AQMD has a strong professional staff with a great deal of autonomy and influence (the staff peaked in the early 1990s at 1,100 persons; following a series of cuts has leveled off at 800 today). It's operating budget has grown to over one-hundred million dollars annually, which is raised mainly from within the region, from five major and several minor revenue streams; operating fees assessed against business and industry, permit processing fees, emissions fees, vehicle registration fees, grants/subventions from EPA and CARB, and several smaller categories. For several decades, AQMD has served as one if not the single most powerful region-wide governing agency, affecting economic development and settlement patterns, and life-style of residents in the multi-county sprawling megalopolis that is Los Angeles.

Box 3: What is the character of air pollution in Los Angeles?

The answer is *SMOG*

- It comes from burning fossil fuels in power plants.
- It comes from the reliance on automobiles and motorized vehicles for transportation.
- It comes from the fact that Los Angeles is situated in a bowl, with mountain barriers to the North and East that trap carbon monoxide, nitrogen oxides, sulfur dioxide, lead and other toxic pollutant, often under a thermal inversion layer. This gaseous brown-grayish haze is

carried steadily inland on the eastward blowing sea breeze, and is "cooked" by the sun into photochemical smog.

- Ozone, the dominant summertime pollutant, has a pungent smell but it is invisible.
- Nitrogen dioxide leaves a brownish smear on the horizon.
- Particulates, or microscopic bits of pollution composed of everything from diesel soot to dust in the air, are responsible for reducing visibility.
- 'Smog' is a mixture of several pollutants, including ozone, particulates, nitrogen dioxide and carbon monoxide.

The *cost* to human health is substantial

- A 1989 AQMD study concluded that if the region were in compliance with state and federal standards, it would gain *\$9.4 billion in health benefits* alone.
- Epidemiologists reported in 1991 a correlation between long-term exposure to air pollution and the development of chronic diseases.
- A study of over six-thousand residents in the basin showed a higher incidence of respiratory diseases, including bronchitis and asthma.
- In the most affected areas of the basin, women showed a third greater incidence of cancer.
- The EPA in 1995 concluded that particulate matter pollution as small as 2.5 microns in diameter and smaller (regulations are set today at 10 microns) is causing an estimated 275 deaths annually in the Inland Valley of the basin.

- A 1996 study by the Natural Resources Defense Council reported that fine particulate pollution kills 8,800 people prematurely each year in the South Coast Air Basin.
- In 1998, the results of a 15 year study of cancer among 6,338 non-smoking Seventh Day Adventists found a link between particulate pollution, sulfur dioxide and ozone and lung cancer.
- In 2005, the results of a 10-year study by the University of Southern California, Keck School of Medicine, showed that children growing up in the thickest ozone regions had 10-20% reduced lung capacity.

Over the past three and a half decades hundreds of air emission controls have been placed on business, industry and local communities and government agencies, large and small, to reduce the level of the “principal” pollutants set forth in the 1970 Clean Air Act—*ozone, nitrogen dioxide, particulates, fine particulates, carbon monoxide, lead, and sulfur dioxide*. In the mid-1990s, the regulatory net was extended to cover emissions of benzene, chromium, arsenic, and more than 100 other toxic chemicals, from approximately 250 of the largest emitters in the region. AQMD focuses not only on stationary sources of the pollutants, but its activities have a significant bearing on land-use and transportation decisions throughout the basin even where it does not have direct regulatory authority.

AQMD’s multifaceted strategy for reducing air emissions has focused on everything from outright banning of highly toxic and polluting products to supporting research into less pollution technologies for use in business and industry, and very low emitting cars, trucks, and buses. It has pioneered

in efforts to directly affect the behavior of individuals in their driving habits through developing programs of ride-sharing, telecommuting, and shifting driving to non-peak hours. AQMD's Commuter Program covers 6,000 companies employing two million people, where employers are required to encourage their workers to car-pool, use public transit, or bicycle to work rather than drive alone in a car.

Box 4: The 50 Year Saga of Air Pollution in Los Angeles

- In 1943, Fletcher E. Bowron, Mayor of Los Angeles, announced that the city's smog would be eliminated within four years.
- In 1946, the County of Los Angeles established its first major air pollution control agency.
- In 1949, A.J. Haagen-Smit, a biochemist at the California Institute of Technology, announced that the automobile was a prime cause of smog.
- In the mid 1950s, the State of California created an agency to monitor and control motor vehicle emissions and in 1959 gave the Department of Public Health authority to determine air quality and motor vehicle emission standards necessary to protect health, crops and vegetation.
- 1963 saw the adoption of the Federal Clean Air Act, providing the states technical assistance; it was amended in 1967 giving states primary responsibility for air emissions.
- In 1966, California established the first auto emissions standards, two years ahead of the Federal Government.

- In 1970, the Clean Air Act was passed by Congress giving responsibility to the EPA to develop national standards and to implement them. A few of the notable consequences being:
 - Establishing CAFE or automobile fleet mileage per gallon of gasoline Standards;
 - Introducing catalytic converters in automobiles;
 - Phasing out leaded gasoline.
- In California, in the 1970s, a shift was made from burning coal and oil to less polluting natural gas for energy in business, industry, and the electric utilities.
- In 1977, the South Coast Air Quality Management District was established by the State of California, to address comprehensively the air pollution problem not only of Los Angeles, but of its surroundings.
- After repeated delays in meeting air quality targets—first it was 1975, then 1977, 1982, 1987, and 1988—and nonstop political negotiation, Los Angeles was granted until the year 2010 to meet Federal air quality standards, under the Clean Air Act of 1990. In 2004, the deadline was further extended to 2015.
- Cars and light trucks account for 65-70 percent of the air pollution over the Los Angeles basin. The automobiles produced today are far cleaner running than their 1970s counterparts; emissions from cars today is only 10 percent of that produced in the 1970s.
- In 2005, heavy duty diesel engine trucks, mostly associated with goods movement from the ports of Los Angeles and Long Beach, remained the single largest contributor to mobile source emissions.

- In 2000, EPA established more stringent standards for sulfur emissions from trucks, but only as applied to new trucks.
- EPA will be phasing in more stringent standards for sulfur emissions from locomotives, over five year period beginning 2007.

AQMD has lead the way in the state and nation in setting standards for emissions from gasoline, solvents, oil-based paints, barbecue lighter fluid, and other commercial products, with the result that most have been reformulated or redesigned by their manufacturers to be less polluting. A permitting system specifying emission caps on industrial machinery and equipment has been instituted, as well as a permit system for an entire facility. Today, there are over 31,000 businesses covered by AQMD permit program, with emission limits enforced through periodic facility inspections and violators susceptible to fines and civil penalties. Educational campaigns have been conducted to raise the public's awareness of the need for the strong steps taken to reduce air pollution. Research and development has been funded to devise less polluting technologies for industry, business, transportation, and the home.

Approximately 30-40% of the air pollution in the Los Angeles basin originates from the manufacturing facilities and products that AQMD regulates directly. The remaining 60-70% originates from mobile sources; cars, buses, trucks, trains, airplanes, and ships, which are under the regulatory supervision of EPA and the State of California's Air Resources Board (CARB), thus not AQMD. While the reach of AQMD to these mobile sources is therefore indirect, it is ever-present. For example, with the strong backing of AQMD, new cars made for sale in California are required

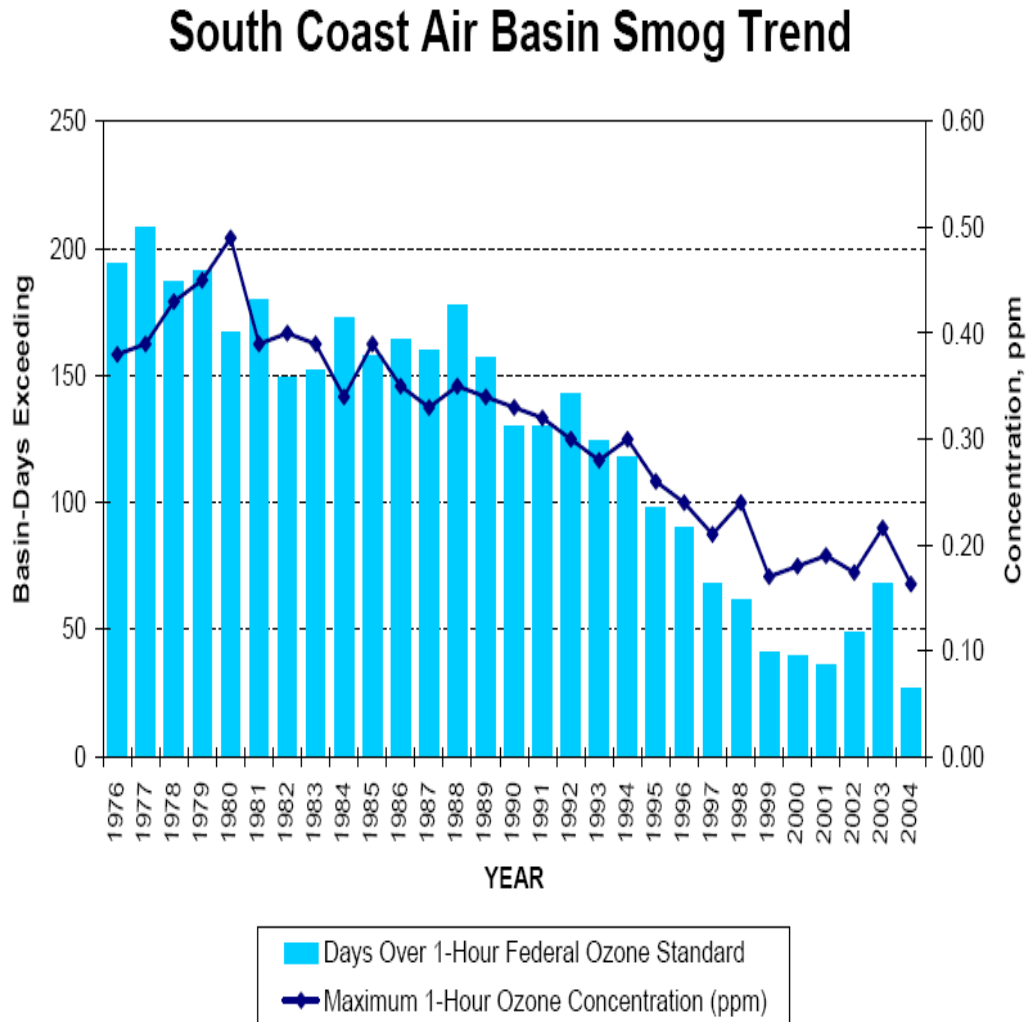
to be equipped with pollution controls that make them the cleanest internal combustion engine vehicles in the world, burning the cleanest fuels.

Emissions Reduction Accomplishments: A Cup Half Full or Half Empty?

Despite its substantial efforts at clearing the air, for thirty-five years Los Angeles has had the unenviable distinction (periodically shared with Houston, Texas) of being the most serious nonattainment metropolitan region in the United States. Less recognized is the fact that there has been a nearly unbroken downward trend in health alerts and emission violations in the region, more dramatic in relative and per capita terms than in any metropolitan area of the nation. The per capita reductions have occurred at the same time the region has been rapidly expanding, with unprecedented economic growth and dramatic urban sprawl.

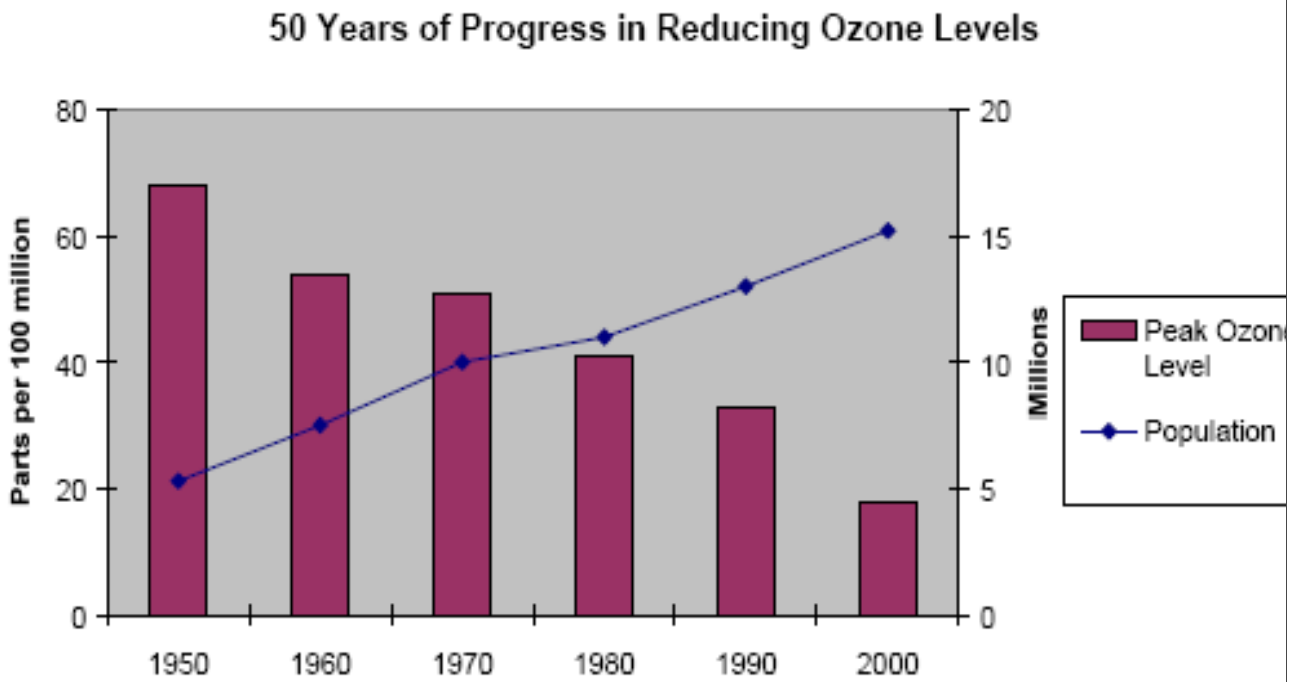
When viewed in this context, the accomplishments of the region's efforts are remarkable. The region has seen a significant decline in the most severe health alerts, and stages one, two, and three alerts are almost non-existent today. The summer smog season of 2004 ended as the cleanest since monitoring began in 1955. In 2004, there were 4 days with health advisory alerts, in comparison with 96 in 1994, with 146 in 1984, and the highest of all, 184, occurring in 1977. Peak concentrations of ozone, one of the toughest emissions to eradicate, have declined from a high of over 200 days in 1980 to under 70 in 2004.

Figure 2:



Source: South Coast Air Quality Management District, “2004 Cleanest Year on Record,” <http://aqmd.gov/news1/2005.html>.

Figure 3:



Source: South Coast Air Quality Management District, "Draft Budget & Draft Work Plan, Fiscal Year 2005-2006." May 10, 2005, p. 2.

When Doing Good is Not Good Enough

Undeterred by the air pollution control strategies that had become synonymous with the AQMD, new residents continued to stream into the Los Angeles in large numbers in all but a few years since air emission controls were initiated. They have been attracted by jobs and opportunities, the region's extensive cultural and natural amenities, and its reputation as the immigrant gateway to the United States, most notably from Mexico, Central America, South Korea, and Southeast Asian countries. Since the end of World War II, the population of the four-county Los Angeles air basin has more than tripled in size from 4.8 to over 16 million people, at a time the total U.S. population was doubling in size. Even more dramatic as an impact on air quality, the number of motor vehicles in the region quadrupled from 2.3 to more than 10 million. Similarly, there was comparable growth in the number of trains, ships, and planes entering and leaving the region, and with all this, ever-worsening traffic congestion.

Never has the AQMD had the authority, the political will, or the administrative capacity to curb this growth despite its obvious link to the air pollution problem of the basin. Consequently, much of the gains in *per person* emission reduction achieved through the efforts made in the 1970s thru 1990s were off-set by the region's growth.

After more than a decade straining to meet the emissions goals of the 1970 Clean Air Act, in the early 1980s resignation set in among Los Angeles's government and business leaders. The issue reached crisis proportion over the AQMD's 1982 Implementation Plan to reduce ozone.

Rather than spelling out how the region would come into compliance with the ozone standard, the plan did not foresee bringing the region into compliance for at least twenty more years. EPA, which was required to ensure that all state and regional plans met the requirements of Clean Air Act, nevertheless accepted the region's assessment.

Yet, the Clean Air Act granted regions only five years to come into compliance. In response to the region's position, in 1984, environmentalists from the Coalition for Clean Air, a locally based environmental group, supported by the Sierra Club, turned to the federal court. They filed a suit with the US Federal District Court in Los Angeles, against the EPA and the AQMD for promulgating a plan that knowingly failed to provide a persuasive and realistic strategy for complying with the Clean Air Act. The suit dragged on for four years until the judge ruled in favor of the environmentalists. It ordered the EPA to develop its own implementation plan for the region in the face of the district's inability to do so. The ruling became the legal backdrop of the renewed efforts and cleanup initiative in the region of the decade to come.

It was at this point in the history of AQMD that, in 1986, Jim Lents was recruited to be Executive Director of the agency. He had been successful in helping the City of Denver to address its air pollution problem and he was determined to do the same for Los Angeles. Reflecting back on this transition period, Lent's mused that

“The unstated position of the agency between 1977 and 1986 was ‘we will try to improve the air quality, but Los Angeles is never going to have clean air’...In 1987, however, we decided that would no longer

be the case, that it is our mandate to have air in this basin that is healthy to breathe” (Waldman 1991, 170).

Under Lent’s leadership, air pollution policy became a driving force in Los Angeles, affecting every thing from energy and transportation decisions—including development of a light rail, low emitting diesel powered locomotives, improved internal combustion engines, and the zero emitting and low emitting vehicles mandated for the region—to urban planning, waste management, home and community landscaping. By the end the 1980s, the AQMD board had emerged as a *de facto* regional government for the multi-county megalopolis of Los Angeles. The district had developed substantial administrative capacity, employing over a thousand staff, with over a hundred-million dollar annual operating budget, in a new headquarters building. With authority over the stringent new-source review rules for air pollution being applied to businesses and industries seeking to enter the basin, combined with the provision in Federal, state and regional law that prohibit any significant deterioration in air quality, AQMD became a key arbiter of what industries would be allowed in and which ones could realistically afford to stay in the region, and where they would be located.

The AQMD 1991 Plan: The High Point in Air Emissions Regulatory Policy

The release by AQMD of its 1989 and the slightly modified 1991 regional air quality plan was the toughest, most intrusive set of air emission regulations ever in Los Angeles, or anywhere. They came in three tiers:

- **Tier I** comprised 130 control measures that AQMD stated could be adopted in the short term, using current technology and existing regulatory authority. They included measures such as ridesharing and alternative work hours, waste recycling, and using less pollution emitting building materials.
- **Tier II** controls were mostly extensions but also some more stringent applications of the Tier I controls. They included "on the horizon" technologies and policies that could be expected to be developed by the year 2000, such as telecommunication technologies and less polluting alternative fuels.
- **Tier III** were controls that would involve major technological breakthroughs of the type that were expected to emerge over the next two decades, including commercial applications of fuel cells, superconductors, and wide-spread adoption of solar power in homes and industry.

Several benefit-cost analyses were conducted on the new plan, by the agency, business interests, and environmentalists, though without satisfactory result. Their differences were in part technical, but also economic and political, turning mainly on assumptions about the likelihood of the development and use of new technologies, and who was to bear the cost of the proposed control measures. While it was possible to gauge most of the near-term costs of imposing stricter controls, gauging their long-term costs was more difficult. There was also significant uncertainty and disagreement about the dollar value of human health, the quality of life, and the environment of the basin that would result from the plan.

According to the plan, AQMD would be responsible for carrying out many of its provisions, but others would need to be implemented by CARB, EPA, local governments, transportation agencies, and other special districts and governing entities within the region. The list of control measures was extensive and would require coordination across a myriad of local, state, and federal agencies, as is indicated by the examples given in *Box 5*.

The plan was clearly ambitious. It called for tough new policies and enforcement, and sacrifices by business and industry, the motoring public, and all the residents of the basin. It required the full cooperation of all affected local, state, and Federal agencies. It proved so sweeping in its potential impact on business and governmental agencies that it prompted the Los Angeles Chamber of Commerce along with a few local political officials to consider establishing a general purpose regional government that would counter-balance the authority over the region being amassed by AQMD.

Box 5: Agencies Responsible for Implementing the Control Measures in the AQMD Air Quality Plan 1991

Control measures to be implemented by local government

- Alternative work weeks and flextime;
- Employer rideshare and transit incentives;
- Local government energy conservation program;
- Emission reductions from swimming pool water heating;
- Low emission materials for construction activities.

Control measures to be implemented by AQMD

- Control emissions from petroleum refinery flares;
- Banning new drive-through facilities;

Telecommunications;
General aviation vapor recovery.

Control measures to be implemented by transportation agencies

Traffic flow improvements;
High speed rails;
Diverting port-related truck traffic to rail;
Freeway and highway capacity enhancements.

Control measures to be implemented by state and federal agencies

Lower emissions standards on new jet aircraft engines;
Control of fugitive emissions from marine vessel tanks;
Alternative work weeks and “flextime”;
Employer rideshare and transit incentives;
Local government energy conservation program;
Emission reductions from swimming pool water heating;
Low emission materials for construction activities.

The Federal Implementation Plan

If this were not enough, in early 1993 the U.S. Supreme Court denied EPA’s appeal to overturn the decision reached in the U.S. District Court’s in 1988; the decision in favor of the environmentalists and against EPA and AQMD requiring a plan for reducing ozone in the region. As a result, EPA was directed by the court to devise a convincing mega-plan for the Los Angeles region, a “Federal Implementation Plan” (FIP). The outline of the EPA Plan was released in early 1994, and reached to sectors only barely touched on up to that time by AQMD, including trains, ships, port

authorities, and commercial airlines. The draft plan went so far as to threaten the rationing of gasoline in the basin in order to curtail automotive emissions. Realistically, EPA knew that even using the full regulatory powers at its disposal that it was not likely to win over the local political and economic leaders who were the main sources of resistance. Therefore, it publicly challenged the region–AQMD, business, industry, and other community interests–to devise its own new and comprehensive implementation strategy, thus avoid having EPA impose one. This was to no avail.

According to the Supreme Court, the FIP was to be in place by February 1995. It was, but it arrived still-borne. The combination of strong political resistance from truckers, shipping and airline industries, local business, the utilities, automotive manufactures, oil companies, local governments, and others was overwhelming. The timing of the release of the FIP, in the midst of the longest recession in the region since the Great Depression of the 1930s added significantly to the opposition. If there was any doubt about the strength of the opposition to the FIP and what it required, and the shift in the public’s concern with the recession in the months prior to the elections of November, 1994, the election of an anti-environmental Republican Congress in Washington and Republican majority in the California legislature removed that doubt.

A political resolution to the impasse over the air quality plan for Los Angeles quickly followed the election, negotiated behind the scene in Washington. It was agreed that the State of California’s air quality plan (the State Implementation Plan or SIP), that already had been approved by EPA, would be interpreted by EPA to cover the South Coast Air Quality Management District for the purpose of compliance with The Clean Air Act

planning requirement. The environmentalists were told that if they did not abide by this resolution and contested it in court, the newly empowered Republican Congress would rewrite the Clean Air Act with a high probability of weakening the Act's goals and strict timelines. While the concerns about timing and the adequacy of the region's clean air strategies would again resurface in the coming years, for the moment the tide had turned. This episode marked a shift in the political influence of the environmental and health care advocates for clean air in Los Angeles and the aggressiveness that have developed in AQMD. The champions of clean air would have to develop a new approach.

In looking back, two conclusions seem warranted. The command-and-control strategy did bring the region substantially along the path toward attaining Federal and state air emission standards. However, under the assumption that the region's population would increase up to 40% by the year 2040, with the added economic growth, vehicles miles traveled, and congestion this implied, it was highly likely that emissions, particularly of ozone precursors (NO_x and ROG_s), would reverse their declining trajectory. Thus, for the region to achieve state and Federal emission levels in the face of continuing growth, it would need to reduce hydrocarbons emissions by upwards of an additional 80 percent, nitrogen oxides by 70 percent, sulfur oxides by 60 percent, and particulates by 20 percent. If the regulatory strategies for emission reductions had peaked, how then were further significant reductions going to be achieved?

Market-Based Approaches

From the outset of the struggle to clean the air, the challenge to policy-makers had been to achieve a balance between the reduction in the

emissions required by law and growth. To the extent that end-of-the-pipe emission controls (such as the catalytic converter on cars and scrubbers on smoke stacks), production-line modifications, and less polluting products could be introduced without undermining the region's economy, increasing regulation did not cause an inordinate amount of economic and social disruption. In essence, despite the complaints from the business community throughout the first two decades under AQMD and the Clean Air Act, the regulatory strategy worked. In the early 1990s, however, circumstances had changed. Also, by this point in time, most of the major stationary sources of air pollution in Los Angeles—businesses, industries, the utilities—and the major mobile source—the automobile—had been captured within the regulatory net. Therefore, even if one wished to substantially reduce emissions further using a regulatory approach, the net would need to be expanded to the thousands of small emitters and minute sources of emission. This was not politically attractive or administratively feasible.

The political shift in the broader society also affected AQMD's appointed board of governors, which began to mirror the broader political transformation in the state and nation. The new board members moved quickly to change the image and strategy of the agency. Their approach was made evident when they released the 1993, revised AQMD plan. Market incentives was the catchword of the plan. Nearly one-hundred market-based measures were identified and a new implementation philosophy was declared, aiming at 75% of all smog causing activities, with proposals for:

- Fees on car miles driven and on fuel consumption;
- Credits and rebates for cleaner technologies;

- Financial incentives to switch to electric vehicles or low emitting vehicles and fuel cell vehicles;
- Planting of carbon absorbing and shade trees;
- Credits and rebates for energy efficient houses and businesses;
- Expansion of the market-based ‘cap-and-trade’ program for nitrogen oxides (NOx) and sulfur oxides (SOx) introduced the previous year to volatile organic compounds (VOCs).

Removed from the plan were the previous controls on many “indirect sources,” special events centers, shopping centers, airport ground access, trip reduction requirements for schools, and other controls on commerce and business.

RECLAIM

In 1992, and foreshadowing the 1993 plan, AQMD adopted the Regional Clean Air Incentives Market program or RECLAIM, a unique policy for the region and nationally whereby operators of large industrial facilities would be required to buy and sell emission permits into an open market, in sulfur oxides (SOx) and nitrogen oxides (NOx), as part of the facility’s strategy to achieve its required air emissions reduction. The concept was a straight forward application of micro-economic theory. If top-down, command-and-control regulations could be replaced with a market-based system, the result would be lower total costs to industry, greater flexibility in how industry accomplished emission reduction, and lesser government bureaucracy.

At the start of RECLAIM, each facility that participated was allocated permits, in pounds, for one year, allowing the emission of NO_x and SO_x. The allocations were based on a bench-mark year. The amount permitted was to be reduced each year thereafter by 5-8% in order to achieve a region-wide reduction of 83% in NO_x and 65% in SO_x by 2003. It was assumed that after 2003 additional targets would be established, depending on the needs of the region. This has occurred.

A permit holder can exercise the permit by emitting up to the allocated amount or reduce emissions and sell the remaining permits back into the market. As an additional incentive, participating companies were granted fast-track, “one-stop shopping” by the AQMD for all their major permit needs. RECLAIM replaced about sixty command-and-control regulations. The overall cost savings to industry was estimated at upwards of half of compliance costs of traditional regulation.

Since its inception, RECALAIM has grown into the largest urban region emission trading program in the United States. With the first two years it had been extended to 329 of 31,000 industrial facilities—including the 300 largest—and covered more than 50% of the NO_x and 90% of SO_x emissions from all facilities regulated by AQMD. Within four years, the number of transactions among facilities had grown to over four hundred, with nearly thirty thousand tons of NO_x credits and thirty thousand tons of SO_x credits chancing hands (AQMD Advisor, July 1998). While the program has had its critics (Drury 1999), it continues to be the primary strategy for reducing emissions from the regions largest facilities, with the permissible overall emissions of SO_x and NO_x covered under the program progressively reduced by the AQMD in each year of the program’s existence (AQMD Advisor, March 2005).

While many environmentalists supported the idea of RECLAIM, others opposed the program because the short term environmental relief would be small. This resulted from the political compromise that led to the initial allocation of credits, based on a firm's historic average maximum emissions when the economy was in recession and industrial production was at a low point. Others argued that the program's size (limited to 300 plus large firms) would keep demand and supply of permits limited, and thereby inhibit the development of a large and efficient market. In spite these concerns, the benefits in both the decrease of command-and-control rules and the growing market in trading argues persuasively that RECLAIM is working, and continues as the largest metropolitan experiment to date in emissions trading under the Clean Air Act.

However, and significant in considering future developments, while successful in application to SO_x and NO_x, RECLAIM failed when AQMD attempted to apply the program to volatile organic compounds (VOCs), in the mid-1990s. The absence of prior command-and-control regulations over the affected firms and the broad sweep of VOC emitting businesses appears to have been at the root of the failure to adopt of the approach (Dale 2000).

VTM

Additional incentive-based approaches to emission reduction were considered in the early to mid-1990s as the new market-based philosophy was being embraced by AQMD. Several of the ideas were prompted by Federal transportation law that required transportation planners to design policies that simultaneously reduced highway congestion and air pollution. The simultaneous achievement of both goals can, in theory, be realized through the introduction of market-based schemes, such as congestion

pricing, smog fees, gasoline taxes, and incentives for the purchase of smaller and low emitting vehicles.

The approach that came closest to adoption in Los Angeles and statewide was the ‘vehicle-miles-traveled’ fee, or VMT. In the early 1990s the VMT was endorsed by a coalition of business leaders, environmentalists, the regional association of governments, and academics. The VMT is based on the number of miles driven a vehicle is driven. It has the virtue of being a direct and equitable fee, in that all automobiles are charged the same amount, per mile, for use of the roadways. Several technologies exist for reading a car’s mileage electronically, thus the system can be designed to be unobtrusive.

The fee was viewed, also, as a replacement for the state’s declining gasoline tax base that was declining as cars became more efficient. Using the VAT for operating revenue for the state’s highway and road system would allow shifting from the tax on gallons of gasoline consumed to miles traveled. To the extent that the VMT became an incentive to move people to public transportation, ride-sharing, and trip reductions, the less the roadways would be congested. Air quality would benefit doubly under this scheme, both from the fewer total miles of driving in the basin and the reduction in congestion, which itself is a major cause of auto emissions.

Setting the actual fee level for the VMT was a major point of contention. Representatives of the Los Angeles business community proposed a revenue-neutral one cent per mile, or \$100 for every 10,000 miles of travel. Small and Kazimi (1994), using a health-cost criterion, estimated that cost of the health effects of auto emissions could be captured with a three cents per mile fee on cars (equal to approximately 30 cents per gallon of gasoline) and a fifty cents per mile fee on large diesel trucks (to

offset their disproportionate contribution to the adverse health effects of the region's air pollution). The Environmental Defense, an environmental NGO, argued that a five cent per mile fee would be needed to achieve the optimal amount of reduced congestion and pollution.

The VMT failed to attract sufficient public and legislative support, however, and has not received serious consideration in policy circles since. Nevertheless, it remains as one of the more attractive incentives-based approaches for simultaneously reducing automotive congestion and air emissions in the region.

Public Expectations

Californians cherish their natural amenities, moderate climate, outdoor recreational opportunities, and believe a clean and pristine environment is a matter of “right”. This is deep in the culture, reaching back to the state's banning of the environmentally destructive hydraulic mining for gold in the 19th century. In the early 20th century, John Muir memorialized this ethic in his writing on the Sierra Nevada Mountains. It is reflected in the many national, state, and local parks and wildlife habitat preserves that have been established in the state. In the modern environmental era, California was often the first and usually the most demanding of business, industry, and the general public.

Absent the backdrop of public expectation and political activism, it is unlikely that local and state political leaders would have taken the lead in developing strong air (and water, toxic, noise, and land use) pollution policies in the 1960s-1990s, and supported the administrative capacity to enforce these policies. Indicative of this backdrop support, in 2005, 48% or nearly half of all Californian's, were “extremely concerned” with the environment (as opposed to “somewhat” or “not at all” concerned) when

surveyed by the Field Research Poll. The proportion “extremely concerned” was the same for young and the old, for northern and southern Californians, and the better and less well educated. Self-identified Democrats were more concerned than Republicans, and women more than men. The overall level of concern with the environment was greater than for terrorism, energy, or taxes, though lesser than with education and schooling, health care, and the overall well-being of children.

Even in the aftermath of the dot-com stock-market crash in 2000-2001, the state’s dire fifteen billion dollar shortfall in its annual operating budget, and national concern with terrorism, “extreme concern” with the environment remained at 50% and, air pollution, in particular, was viewed as “the most important environmental issue facing the state...followed distantly by growth and development, water, ocean, and beach pollution and water supply.” (Public Policy Institute of California, “Surveys on Environment: 2002,” PPIC: San Francisco, CA).

Systematic public opinion data reaching back to the outset of the modern environmental movement in the state, in the 1970s, is not available. However, the Field Poll has traced the public’s concern with environmental issues over the past twenty years, and the results show that today’s 50% level of “extreme concern” is down from even higher earlier level, reaching 63% in 1986. At this same time, concern with air and water pollution measured 68%

Organizing for Environmental Protection

Concern by Californians with environmental quality is one of the most important factors in the ability of AQMD to impose regulations on business, industry, and the public. Organizing to represent this concern in the

electoral arena and before public agencies has been a number of local and national non-governmental organizations (NGOs). Most noted among these has been the Sierra Club, founded in California in 1892. While based in the state, it grew into a national and politically active organization in the 1970s, expanding membership four-fold in the two decades following Earth Day 1970. But the Sierra Club was only the first.

With the environmental movement came Environmental Defense (1967), Friends of the Earth (1969), the Natural Resources Defense Council (1970), the League of Conservation Voters (1970), and a dozen additional national environmental organizations that have emerged since. They champion environmental legislation, publicize the ecological and human health consequences of pollution, lobby legislatures and local officials and, when policy implementation is lagging or impeded, turn to the courts. In addition to the national organizations, many local environmental and health groups exist. Particularly important with respect to air pollution issues are the Coalition for Clean Air and the American Lung Association of California. Understanding the deep and enduring nature of public support for environmental quality helps explain why the issue has remained of foremost importance politically in the state, and why AQMD has been able to insinuate itself into the life of the region.

Of course, there is always reticence on the part of citizens' to change their own behavior. Evidence of this comes from a survey of the public's willingness to change driving and commuting habits to reduce air pollution. In a survey of Los Angeles, conducted by Professor Dan Sperling, of the University of California, at Davis, citizens revealed that they were far more willing to "pay" for cleaner technology than change driving habits.

“Over half (57%) the respondents expressed willingness to purchase an alternative fuel vehicle as a response to air pollution problems, compared to only 17 percent who were willing to carpool, 16 percent who would use mass transit, and 6 percent who would walk or bicycle” (Sperling, 1994, p. 13).

Looking back over the past three and a half decades, it would appear that preference for technology solutions has characterized both the public and business.

Environmental Justice Impacts of Goods Movement

In Los Angeles today, the air pollution agenda is dominated a set of inter-related issues brought about by the importance of goods movement, the fastest growing component of the region’s economy. With the globalization of manufacturing and changing patterns of production and distribution over the past two decades, extending today from Asian manufacturers to North America consumers, Los Angeles has become the nation’s largest containerized shipping port of entry—third largest worldwide—through which pass 40% of all containerized goods entering the United States.

There is no doubt that the economic benefits of goods movement to the region are substantial. So too the challenges; challenges of distributing goods across the basin and the nation, work force needs and job training, transportation infrastructure planning and development, and coping with the concentration of diesel emissions from the cargo ships, trains, trucks moving into and out of the port, which by 2005 had reached a critical threshold. Goods movement has become the growth driver, on the one hand, and on the other the most severe air pollution, health and environmental justice challenge facing of Los Angeles today.

The California Air Resources Board reports that the largely unregulated NOx from the cargo ships alone is likely to grow to 250 million tons daily over the next fifteen years unless major steps are taken to curb the emissions; this compares to 130 tons from trucks and 77 tons from locomotive trains operating in the state today (Schoch 2005). Emissions that disproportionately affect the health of the children of the mostly poorer, working class, and minority populations in the neighborhoods surrounding the ports and along the major trucking corridors leading from the port connecting to the nation's interstate highway system (AQMD, Work Plan 2005-2006).

AQMD is responsible for addressing the health and equity implications of air emissions under both EPA policy and its own environmental justice policy. Yet, it is the state and federal governments that regulate the trains and trucks involved in the goods movement, under the interstate commerce clause of the Federal Government. In the case of shipping, oversight is by a mix of federal and international maritime regulations. This has not deterred AQMD from taking the lead in promulgating a set of guiding policy principles and action measures in a "Clean Port Initiative," adopted by the board in November of 2005; the Initiative's four principles and seven measures are listed in *Box 6*. What AQMD can implement under its own authority, it promises to do so and, where it lacks formal authority, it promises to work with CARB, EPA, the state legislature, Congress, and with the ports in Los Angeles and Asia, and the transport industries directly to clean the air.

Box 6: AQMD's Clean Port Initiative of November 2005

Four Guiding Principles

- AQMD acknowledges the efforts of both ports [*the adjacent ports of Long Beach and Los Angeles*] to date in recognizing their air pollution problem and taking initial steps to address it;
- The proposed No Net Increase plan for the Port of Los Angeles is a good start, but it's not enough. The ports need to reduce their emissions to achieve clean air;
- The ports of Los Angeles and Long Beach must pursue coordinated emissions-reduction strategies to ensure equity and to prevent one port from obtaining a competitive edge through less stringent environmental standards; and
- The ports and shipping companies should bear their fair share of the cost of cleanup, just as stationary sources do today.

Seven Action items

- AQMD will request a Clean Port Summit meeting between Chairman Burke, Los Angeles Board of Harbor Commissioners President S. David Freeman and Port of Long Beach Commission President Doris Topsy-Elvord to discuss development and coordination of fast-track measures that can be pursued now to reduce air pollution;
- If the ports do not act aggressively and in a timely, coordinated manner to significantly reduce their emissions, AQMD staff will develop regulations to the maximum extent of its authority to control port sources, including ocean-going ships;
- Starting next year, AQMD staff will prepare a monthly report to the public describing environmental impact reports and other CEQA documents for projects related to goods movement. In addition, AQMD

staff will make full use of CEQA [*California Environmental Quality Act*] documents for projects related to goods movements. In addition, AQMD staff will make use of the CEQA process for such projects to ensure that their impacts are thoroughly mitigated;

- AQMD staff will work with the ports to conduct air quality monitoring, not only outside the ports' boundaries, but also within the port terminals;
- AQMD will call on the U.S. EPA to adopt strict emission standards for marine vessels. If EPA fails to do so, AQMD will ask California's Congressional delegation to sponsor legislation or take other action to force EPA to take aggressive action;
- Focusing on the top three busiest ports in Asia, AQMD staff will develop a proposal for joint emission reduction measures here and at those Asian ports. AQMD will then coordinate an international summit with Asian port officials to discuss how to implement these measures;
- AQMD will call on the state Legislature in 2006 to adopt a shipping-container fee or some other mechanism that is sufficient to fund cleanup at the ports.

To accomplish the ambitious goals of the Clean Port Initiative new technologies, systems management, and logistics measures will be needed, and most if not all the measures being called for implemented. It can be assumed the cost will be substantial; from converting the trucking fleet and trains to low emitting and non-emitting fuel sources, adding new lanes to relieve truck congestion on the region's highways, construction a trucks only

highway through the region, construction of a new train route through the region, and working in tandem with the ports, both in LA and in Asia. It is also reasonable to assume, based on the history of the AQMD that the air emissions from the port will be brought into alignment with the goals of the region.

Providing grounds for some optimism, a recently announced “Green Freight Initiative,” by a coalition of the leading business interests throughout all of Southern California, holds the possibility those solutions to the environment and health challenges of goods movement will be found by government and industry working together. This is the promise of the business leaders who have launched the new initiative and has been affirmed by the Governor and his cabinet officers.

Implications of the Los Angeles Experience

In looking back on the more than sixty years of continuous effort to address the air pollution problems of Los Angeles, a number of observations can be drawn from the experience about the requisites of developing a system of effective environmental governance.

History: Environmental governance is both a function of a community’s political and economic past practices, combined with the responses chosen to a specific set of environmental problems. This is true for Los Angeles, where little metropolitan-wide governance existed prior to the rise of air pollution as a regional problem and little general purpose regional government exists to this day. Yet a comprehensive, region-wide system of policy formulation and implementing strategies has evolved to tackle the air pollution problem.

Regulations and markets: The Los Angeles experience with RECLAIM reinforces the point made by scholars of environmental policy that command-and-control measures may be required first, and pursued in the extreme, before business, industry, and regulators are willing to embrace and implement major market-based approaches to emissions reduction. What is clear is that both are needed for an optimal strategy.

Technology: The AQMD has relied heavily on a combination of developing/attracting/requiring/incentivizing the use of “off-the-shelf” and “yet-to-be-demonstrated” technologies in bringing about air emissions reduction. This may be a particularly Californian (and American) response to environmental problems, but it should be equally suited to any entrepreneurial, market-oriented society.

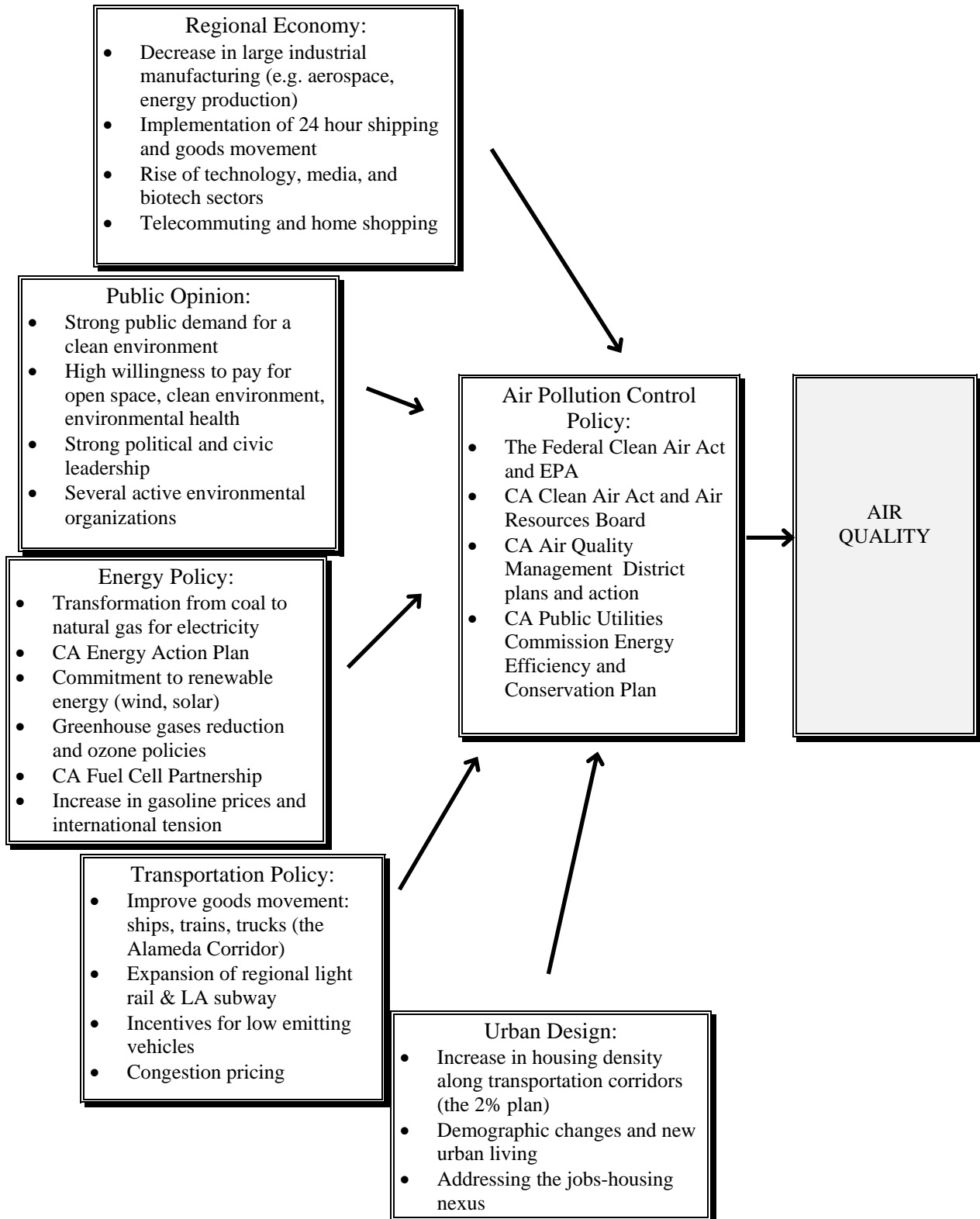
Public Pressure: A significant effort at reducing environmental pollution in the face of the imperatives of growth and development in any society requires a combination of effective public pressure, administrative capacity, and political leadership, combined with external pressure, such as from national (state or provincial) levels of government, or the international community.

Leadership: The experience in Los Angeles demonstrates that dedicated and effective political and administrative leadership is essential—in formulating policy, supporting implementation, rallying the public—to be successful in environmental governance.

Policy Driver: Air pollution has been the driving force in the development of an effective environmental governance regime in Los Angeles. In other community’s water pollution, waste, toxics, greenhouse gas emissions may be the driver, but lacking such a driver it is difficult to imagine the emergence of a strong system of environmental governance.

Success: A successful strategy at reducing major environmental pollution problem, such as a metropolitan region's air pollution, cannot be accomplished operating solely within the bounds of a single medium, or policy, or jurisdiction, or administrative agency. In Los Angeles, the clean air strategy has required attacking the problem through aligning policy in four arenas that had operated independently and largely unaware of their air quality implications. These are the arenas of regional development, urban design, energy, and transportation (depicted in *Figure 4*), which have had be woven together in order to align the people, policies, and actions needed to address the regions air pollution.

Figure 4: Factors Contributing to Los Angeles Clean Air



Bibliography

- Air Quality Management District. General background, history, policies, and facts and figures on pollution trends (see: [Http://www.AQMD.gov](http://www.AQMD.gov).)
- AQMD Advisor. 1998. "First Comprehensive Audit Finds RECLAIM Program Working" (July).
- AQMD, 2003. Air Quality Management Plan. [Http://www.AQMD.gov/aqmp/index.html](http://www.AQMD.gov/aqmp/index.html).
- AQMD, Draft Budget & Draft Work Program, FY 2005-2006. [Http://www.AQMD.gov](http://www.AQMD.gov).
- AQMD Advisor. 2005. "AQMD Orders Further Emissions Reductions From Region's Pollution Credit Trading Program" (March).
- Barringer, Felicity. 2005. "California Air Is Cleaner, but Trouble Remains." *NEW YORK TIMES* (August 3rd).
- Bailey, Christopher J. 1998. *CONGRESS AND AIR POLLUTION*. Manchester and New York: Manchester University Press.
- Bryner, Gary C. 1993. *BLUE SKIES, GREEN POLITICS: THE CLEAN AIR ACT OF 1990*. Washington, D.C.: CQ Press.
- Burtraw, Dallas. 1996. "Tradition Emissions to Clean the Air: Exchanges Few but Savings Many." *RESOURCES*.
- Bustillo, Miguel. 2004. "Smog Harms Children's Lungs for Life, Study Finds." *LOS ANGELES TIMES*. September 9.
- California Air Resources Board. 1994. "The California State Implementation Plan for Ozone." Vol.'s 1-IV. August.
- California Environmental Technology Partnership. 1994. "1994 Plan for Promoting California's Environmental Technology Industry." California Environmental Protection Agency.
- Dale, Thompson B. 2000. "Political Obstacles to the Implementation of Emissions Markets: the Lessons of RECLAIM." *NATURAL RESOURCES JOURNAL* (Summer).
- Dewey, Scott. 1997. "Don't Breathe the Air," Doctoral dissertation in History, Rice University (April).
- Drury, Richard, Michael Belliveau, J. Scott Kuhn, & Shirpra Bansal. 1999. "Pollution Trading and Environmental Justice." *DUKE ENVIRONMENTAL LAW AND POLICY FORUM* (Spring).
- Dwyer, John P. 1993. "The Use of Market Incentives in Controlling Air Pollution: California's Marketable Permits Program." *ECOLOGY LAW QUARTERLY*, 20: 103-117.
- Kamieniecki, Sheldon and Michael R. Ferrall. 1991. "Intergovernmental Relations and Clean-Air Policy in Southern California." *PUBLIUS: JOURNAL OF FEDERALISM*, 21: 143-154.
- Kunzil, Nio *et al.* 2003. "Breathless in Los Angeles: The Exhausting Search for Clean Air." *AMERICAN JOURNAL OF PUBLIC HEALTH* (September). 93: 1494-1499.
- Lents, James and William Kelly. 1993. "Clearing the Air in Los Angeles." *SCIENTIFIC AMERICAN*. Vol. 269: 32-39.

- Popp, David. 2003. "Pollution Control Innovations and the Clean Air Act of 1990." JOURNAL OF POLICY ANALYSIS AND MANAGEMENT, 22: 641-660.
- Schoch, Deborah. 2005. "Study Links Diesel Fumes to Illness." LOS ANGELES TIMES (December 3); B-1.
- Southern California Association of Governments (SCAG). 1994. "Transportation Control and Indirect Source Measures Recommendations from the SCAG Regional Council." Appendix IV-C, 1994 AQMP.
- Small, Kenneth and Camilla Kazimi. 1994. "On the Cost of Air Pollution from Motor Vehicles." University of California Transportation Center, Irvine.
- Sperling, Daniel. 1994. FUTURE DRIVE: ELECTRIC VEHICLES AND SUSTAINABLE DEVELOPMENT. Island Press.
- Sugarman, Stephen D. 1994. "'Pay at the Pump' Auto Insurance: The Vehicle Injury Plan (VIP) for Better Compensation, Fairer Funding, and Greater Safety." JOURNAL OF POLICY ANALYSIS AND MANAGEMENT, Vol. 13: 363-368.
- Swinton, John R. 2004. "Phase I Completed: An Empirical Assessment of the 1990 CAA." ENVIRONMENTAL RESOURCES ECONOMICS. 27: 227-246.
- U.S. Environmental Protection Agency. 2005. "Benefits and Costs of the Clean Air Act." Final Report to Congress on the Benefits and Costs of the Clean Air Act, 1970-1990; EPA 410-R-99-001.
- Waldman, Tom. 1991. "LA air board starts a fresh wind blowing." CALIFORNIA JOURNAL (April).