

Chapter 2

Ozone and The Clean Air Act

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INTRODUCTION

The goal of the Clean Air Act is to “protect and enhance the quality of the Nation’s air resources.” To implement that goal, the 1970 Clean Air Act Amendments required EPA to establish National Ambient Air Quality Standards (NAAQS) to define the level of air quality that is expected to be maintained throughout the Nation. Of the six ‘criteria’ pollutants for which standards have been established, we have been least successful in our efforts to attain the standard for ozone. Nationwide, about 100 areas still violate the ozone standard.

This upcoming reauthorization of the Clean Air Act will be the third time that Congress will specify a mechanism to achieve the goal specified in 1970. To provide context for the remainder of the report, in this chapter we first review the Framework for meeting the ozone standard that was established in the 1970 and 1977 Clean Air Act Amendments and then briefly discuss the State implementation planning (SIP) process. The last section presents some of the reasons why efforts to meet the standard following the 1977 Amendments failed.

EVOLUTION OF OZONE CONTROL UNDER THE CLEAN AIR ACT

The 1970 and 1977 Clean Air Act Amendments established a partnership between the States and the Federal Government. EPA sets nationally uniform air quality standards; and the States, with the Agency’s assistance, are responsible for meeting them. The requirement that the States develop “State Implementation Plans” (SIPS) and submit them to EPA for review allows for Federal oversight of the States’ efforts to achieve and maintain the required level of air quality. In addition to the SIP process, the 1970 Clean Air Act Amendments established two mandatory control programs, one applying to new motor vehicles and the other to new stationary sources. EPA is responsible for setting standards for new motor vehicles. EPA also issues

regulations for new stationary sources, but the program is implemented by the States. The 1977 Amendments added three additional control programs, requiring ozone and carbon monoxide nonattainment areas to apply retrofit controls on existing stationary sources and more stringent emissions limits on new stationary sources, and to develop motor vehicle inspection and maintenance programs.

As defined in the Clean Air Act, “primary” air quality standards represent the maximum allowable concentration of each criteria pollutant that protects against adverse health effects. The primary standards are required to be set at a level that ‘protects the public health’ with an “adequate margin of safety,” without regard to the economic or technical feasibility of attainment. Secondary standards are established to protect against adverse impacts on human comfort and welfare, including impacts on visibility, vegetation, animals, wildlife, materials, and property. The States, together with EPA, are responsible for ensuring that the primary air quality standards are met “as expeditiously as practicable,” within the deadlines specified in the Act. The secondary standards are to be attained in a ‘reasonable’ period of time.

Primary and secondary standards for *oxidants*² were first set by EPA in 1971. In 1979, EPA revised the standards to the current definition. Both the primary and secondary standards for *ozone* are currently defined as a daily maximum, 1-hour average concentration of 0.12 parts per million (ppm), not to be exceeded more than once per year, on average.

In the Clean Air Act Amendments of 1970, Congress set 1975 as the deadline for meeting the primary air quality standards. The States were required to develop and carry out SIPS, estimating the emissions reductions required to attain the NAAQS, and establishing control programs to achieve the required reductions. In addition, EPA

¹The six “criteria” pollutants for which the Environmental Protection Agency has been explicitly required to establish NAAQS are ozone, lead, sulfur dioxide, particulate, nitrogen dioxide, and carbon monoxide.

²Photochemical oxidants are a group of chemical, related pollutants. From the standpoint of health and welfare effects, ozone is the most important of these pollutants. Ozone typically comprises over 90 percent of the total mass of photochemical oxidants measured in urban air.



President Richard M. Nixon signs the Clean Air Act Amendments of 1970.

was required to develop New Source Performance Standards (NSPS) that would be imposed on new or modified stationary sources with the potential to emit more than 100 tons per year of any of the criteria pollutants or of volatile organic compounds (VOCs), one of the two principal precursors of ozone. To enforce the NSPS, the States were required to include construction permit programs in their SIPS. EPA was also required to enforce a specified schedule for reducing emissions from motor vehicles.

By 1977, 2 years after the original deadline, 78 areas were still violating the ozone standard then in place (no more than one exceedance per year of a 1-hour average oxidant concentration of 0.08 ppm). The widespread failure to attain the ozone standard by 1977 has been attributed to the fact that mobile source emissions reductions that the States and EPA were counting on to reduce ozone were not fully realized [3], and that few controls were required on existing stationary sources of VOCs [1]. Due to waivers granted by the EPA Administrator and an extension given by Congress, the schedule specified in the Clean Air Act for tightening motor vehicle emissions limits had not been met. For example, while new car VOC emissions rates were about 60 percent lower in 1977 than in 1970, according to the schedule specified in the Act, a 90-percent reduction should have been achieved. Transportation control

measures such as gas rationing, restricted parking, and restricted freeway lanes generally met with strong resistance; and in 1974 Congress enacted legislation that prohibited EPA from requiring many types of transportation control measures.

In 1977, the deadline for meeting the ozone standard was moved back to 1982. Severe nonattainment areas that did not expect to be able to meet the 1982 deadline could obtain an extension to 1987. Responding to the failure to meet the goals of the 1970 Clean Air Act, the 1977 Amendments included a new and more aggressive control program. New SIPS were to be developed and submitted to EPA in 1979, and again in 1982, for areas seeking extensions of the attainment deadline to 1987. A new schedule was established for imposing emissions limits for new motor vehicles. Existing stationary sources in nonattainment areas would have to be retrofit with emissions controls. A new source could only be constructed in a nonattainment area if it would operate at the “lowest achievable emissions rate” and if emissions reductions could be obtained from other sources to offset the emissions from the proposed source. Transportation control measures would have to be considered. Severe nonattainment areas would have to implement automobile inspection and maintenance programs.

By 1983, 17 areas that had not asked for extensions to 1987 were still violating the ozone standard (which had by that time been revised to its current definition, a daily peak 1-hour average concentration of 0.12 ppm not to be exceeded more than once per year, *on average*). Following its interpretation of the Act, EPA proposed to ban construction of major stationary sources in these areas. However, Congress then prohibited the Agency from using appropriated funds to impose construction moratoriums in areas with approved SIPS. Consequently, the areas that had not met the 1982 deadline were simply required to submit revised SIPS demonstrating how they would attain the standard by 1987. By the end of 1987, no final action had been taken to approve or disapprove any of these SIPS. Since 1983, the Agency’s policy on sanctions has been to restrict their imposition to areas with deficient SIPS or areas that have failed to carry out their SIP commitments in good faith.

In addition to the 17 areas that were supposed to meet the 1982 deadline but failed to do so, approximately 40 ozone nonattainment areas had obtained deadline extensions prior to 1982. These areas were to have submitted SIPS in 1982 that would demonstrate attainment by 1987. EPA promulgated approvals and disapprovals for most of these SIPS in 1983 or 1984. Sanctions were imposed in some areas to spur correction of SIP deficiencies. In July of 1987, EPA proposed construction bans for 11 ozone nonattainment areas that still did not have adequate SIPS.

Some progress has been made since 1977 in reducing emissions of VOCs, one of the two principal sets of precursors of ozone. EPA estimates that nationwide, emissions of VOCs have decreased by about 10 percent over the last decade. The decline in VOC emissions is due primarily to a 30-percent decline in mobile source emissions, which has occurred because of significant reductions in vehicle emissions rates, despite a 25-percent increase in vehicle-miles traveled [4]. Stationary source VOC emissions have increased by about 3 percent since 1977.

Emissions of nitrogen oxides (NO_x , the other principal set of precursors of ozone) are estimated to have declined by less than 2 percent [4].

Despite the progress that has been made in reducing VOC emissions, more than 60 areas still violate the current ozone standard. In November of 1987, EPA proposed a “post-1987” policy for addressing ozone and carbon monoxide nonattainment. Then, on December 11, 1987, Congress extended the deadline for attainment once again, this time to August 1988. The legislation precluded the imposition of the construction bans EPA had proposed in July.

STATE IMPLEMENTATION PLAN DEVELOPMENT AND IMPLEMENTATION

The principal regulatory mechanism by which the air quality standards are to be met and maintained is the State-level process of developing and implementing State Implementation Plans (SIPS). Through the SIP process, the States determine the emissions reductions required to meet the air quality

standard and then set up programs to achieve the required reductions. EPA is responsible for reviewing the SIPS to ensure that they will lead to attainment, and also provides guidance to the States on several aspects of SIP development. In addition to deadlines for attainment of the standards, Congress has also specified deadlines for SIP development.

Developing and implementing a State Implementation Plan for ozone involves a series of steps that are carried out primarily at the State and local levels:

- First, the extent and severity of the local air quality problem is determined by monitoring ambient ozone concentrations. An area is classified “nonattainment” for ozone if peak 1-hour average concentrations measured at any monitor exceed 0.12 ppm more than 1 day per year, averaged over 3 years.
- A critical piece of information required to develop a strategy for meeting the ozone standard is an inventory of VOC and NO_x emissions that covers both stationary and mobile sources. The first step is to estimate current emissions of both precursors. The second is to forecast the changes in emissions that are anticipated to occur in the future without additional local control efforts. Such changes include increases or decreases due to anticipated changes in population, motor vehicle use and industrial activity, and also reductions due to control programs which will be implemented at the Federal level.
- The next step is to use a mathematical model to predict how much emissions will have to be reduced (in addition to the reductions that will be achieved through federally implemented control programs) to meet the ozone standard by the congressionally specified deadline. The predicted control requirement becomes the emissions reduction target for the area.
- The three preceding steps are technically challenging. The fourth step is difficult not only from a technical standpoint, but also from a political standpoint. Each nonattainment area must develop a control strategy that allocates the required emissions reductions among sources in the area, and then design programs to carry out the strategy. A control strategy typically includes imposition of emission lim-

its or control technology requirements on stationary sources, with permitting and source inspection and monitoring programs to ensure compliance. Control strategies may include measures to encourage people to cut back on driving. Retrofit controls on some categories of stationary sources, new source construction permitting programs and motor vehicle inspection and maintenance programs have been specified by Congress as mandatory components of SIP control strategies for ozone.

- Once an ozone control strategy has been developed, the regulations contained in the SIP must be approved through the State regulatory process, and in some cases, by the State legislature. This step alone can be time-consuming. State rulemaking processes typically take from 6 to 11 months [2].
- Once a SIP has been approved at the State level, it is sent to EPA for review. The Agency ensures that the SIP has made the required "attainment demonstration," i.e., that the control measures the State has committed to implementing will provide the level of emissions reductions predicted to be required to meet the standard. The Agency also ensures that the SIP includes all of the control programs that Congress requires. If the States are delinquent in their submittals or submit deficient SIPs, the Agency is required to impose specified sanctions and may impose others at its discretion.
- The first six steps can be regarded as SIP development. What remains is to carry out the regulatory programs contained in the SIP. This includes operating inspection, monitoring, and enforcement programs for both stationary and mobile sources. As SIP implementation progresses, the impact of the SIP is assessed by tracking emissions, and ultimately through monitoring ambient ozone concentrations.
- Finally, the control strategy is revised, if necessary, to resolve problems identified by EPA during its review process, or to compensate for inaccurate predictions of emissions trends or of the efficacy of control measures, or, finally, if the ozone standard is not attained.

EPA participates in SIP development by providing guidance to the States on monitoring, emissions

inventory development, modeling, and on the cost and reduction potential of alternative control measures. Most States rely heavily on EPA as a source of this information. For ozone, the "control technique guidelines" (CTGs) issued by EPA on retrofit control strategies for existing sources of VOCs have been particularly critical. States have not only relied on the CTGs to help identify potential VOC control measures but also to facilitate promulgation of State-level regulations. For example, the existence of a CTG for a particular source can provide leverage in convincing State legislators that the source ought to be controlled.

EPA is responsible for reviewing the SIPs to ensure that they will lead to attainment by the specified deadline and that they contain the required control programs. This process involves repeated interaction between EPA, its Regional offices, and the States.

FAILURE TO MEET THE OZONE STANDARD FOLLOWING THE 1977 AMENDMENTS

More than 10 years have now gone by since the passage of the last major set of amendments to the Clean Air Act, which called for a new and more aggressive control program to attain the ozone standard throughout the country by 1987. While ozone concentrations have been lowered in many nonattainment areas, about 100 areas still exceed the standard. OTA sponsored two workshops involving State and local air pollution control agency officials and current and former EPA staff, respectively, to explore the reasons why this decade-long effort has not resulted in more areas attaining the standard.

Before each of the workshops, participants were asked to complete a questionnaire that suggested possible problems associated with the development and implementation of the ozone control strategy pursued since the late 1970s. The results of the questionnaires formed the basis for further discussion.

Participants at each workshop tended to agree on a few problems that they saw as most significant. However, the problems emphasized by EPA and State regulators were quite different. State and local respondents emphasized the problems of transport of

ozone and ozone precursors, inadequate air quality models, States' inability to promulgate regulations without EPA support, and inadequate EPA performance. EPA respondents most often cited emissions growth, inaccurate emissions inventories, unreasonable deadlines in the Act, and "lack of political will" to solve the ozone problem.

Many of the key problems identified in the OTA workshops were similar to those discussed in a recent General Accounting Office (GAO) report [5]. The GAO investigators also identified problems stemming from inaccurate emissions inventories, flawed modeling, and ineffective EPA oversight. In addition, they found that some control measures planned by States were not implemented or were poorly enforced.

In this section, we will summarize the reasons for continued nonattainment most often suggested by participants in the OTA workshops and in the GAO report. Our discussion begins with "planning" problems, such as inadequate inventories and poor modeling, and continues with the more difficult administrative and political problems, such as the slow pace of issuing control regulations and poor control over emissions growth.

Incomplete and Inadequate Emissions Inventories

An early and extremely important step in developing an ozone control strategy is to estimate current emissions of ozone precursors and to project future emissions in the absence of additional controls. Both EPA and State participants at the OTA workshops suggested that incomplete or inaccurate emissions inventories were a very serious problem. Respondents were particularly concerned that emissions projections made in the past have been too low, thus leading to underestimation of the reductions needed to ensure attainment by 1987. State respondents emphasized that when current SIPs were developed, regulators did not anticipate the gradual increase in gasoline volatility and hence evaporative emissions that has since occurred. EPA participants stressed that in many areas, growth in automobile use has been much higher than originally expected, and as a result automobile emissions have exceeded expectations.

The GAO investigators agreed that the ozone plans they reviewed often understated VOC emissions. For example, they found that "the plan for the Los Angeles area estimated that vehicle mileage would increase 14 percent for the planning period, but the mileage actually increased during the 1979 to 1985 period by 26 percent" [5].

Underestimates of the Extent of Control Required To Attain the Standard

The next step in devising a control strategy is to estimate the extent of emissions reductions necessary. Ozone is formed by a complex series of reactions involving volatile organic compounds (VOCs) and nitrogen oxides (NO_x) in the presence of sunlight. In order to control ozone formation, one must decide how much to reduce emissions of VOCs or NO_x, or both. To do so, regulators have relied on atmospheric models that describe the relationship between VOC and NO_x emissions and ambient ozone levels. Since each nonattainment area is unique due to a different mix of sources and different meteorological conditions, relying on computer models to predict control requirements allowed regulators to tailor control programs to each area's local circumstances.

State and local participants at the OTA workshops suggested that inaccuracy and misuse of atmospheric models were among the most significant problems that contributed to continued nonattainment. They suggested that, due to incomplete scientific understanding of ozone formation, available atmospheric models were (and still are) too inaccurate to derive accurate estimates of the emissions reductions needed to ensure attainment. State participants suggested that state-of-the-art models, which they believe are accurate to within 30 percent at best, are not sufficient to ensure compliance with a standard that allows only 3 exceedances over a 3-year period.

State participants suggested that a second problem with models was that delegation of responsibility for applying models to the States provided them with ample opportunities to cheat in developing their implementation plans, a practice known as "gaming." States were able to choose favorable model assumptions and inputs to arrive at the least stringent predictions of emission reduction requirements.

Many State participants were also concerned that available models do not adequately account for transport of ozone and its precursors. Finally, State workshop participants questioned whether NO_x emission reductions may have been needed in addition to the VOC reductions, which EPA has exclusively encouraged.

In contrast to State and local workshop participants, EPA participants were relatively comfortable with available air quality models. They suggested that uncertainties in modeling are no greater than the uncertainties associated with many other steps of devising and enforcing an ozone control strategy. EPA respondents were also much less concerned than their State and local counterparts with whether NO_x reductions were needed, although they did suggest that NO_x controls might be beneficial in a few areas. However, some EPA participants, like their State counterparts, were concerned that available models do not adequately account for transport.

The GAO investigators pointed out the problems that resulted from the use of modeling with incorrect or inadequate data when preparing SIPS. For example, they pointed out that Houston's 1982 SIP indicated that they needed a 41-percent reduction to attain the standard, but that the analysis relied on some poor quality atmospheric data. When the same analysis was performed by EPA with more accurate data, a 71-percent reduction was predicted to be required [5].

States Had Difficulty Issuing Stationary Source Regulations

Once the magnitude of overall reductions needed has been established, State regulators must decide which sources or source categories will be required to lower emissions, and by how much. EPA provides States with technical guidance concerning the availability and cost of various control measures for new and existing sources. For 29 categories of existing sources of VOCs, the agency issued CTGs that presumptively define the level of controls that EPA considers "reasonably available" (the level of control required for existing sources under the Act). The actual regulations limiting emissions from both new and existing sources were issued by the States. States were required to include regulations corre-

sponding to the CTGs in their SIPS, plus any additional regulations needed to achieve the standard.

State workshop participants pointed out that in many cases reductions due to CTGs alone were not sufficient to attain the standard. They argued that they were unable to promulgate the additional regulations necessary to achieve the requisite VOC emission reductions. First, they suggested that many State regulators face legislative prohibitions or political pressure not to adopt particular control measures unless they are clearly forced to do so by EPA. Second, they suggested that State agencies often do not have the resources or technical expertise needed to develop new regulations on their own. State participants complained that EPA stopped issuing CTGs in recent years, leaving them without a clear Federal directive to issue particular regulations and without the resources to develop their own regulations. They also argued that it is more resource efficient for EPA to develop regulations or CTGs once than for each State to duplicate the activity.

In their own defense, some EPA participants suggested that the Agency stopped issuing CTGs in the face of resistance from the Office of Management and Budget (OMB). One participant suggested that after OMB reviewed them, the most recent group of CTGs were "so watered down that it may have been better not to issue them." Other EPA participants argued that budget limitations were much more significant than OMB review.

The GAO report provides some specific examples of areas that did not implement all of the measures they needed to attain the standard. The report states that in Los Angeles, about half of the stationary source control measures committed to in their SIP were not implemented as of 1986. GAO concludes that "in general, the measures had not been implemented either because the control technology was not fully developed or the local air quality board considered the measures too costly given the expected reductions" [5].

Poor Control Over Emissions Growth

In order to meet the air quality standard, nonattainment areas needed to both reduce existing emissions and ensure that new sources of emissions were offset by additional reductions from existing

sources. EPA respondents most often cited emissions growth as the most important reason for the widespread failure to attain the ozone standard. As suggested above, growth in automobile use was seen as particularly problematic. Although many areas experienced a net decrease in mobile source emissions as a result of more stringent tailpipe emission standards, the reductions were often less than anticipated due to higher than expected automobile use. Workshop participants also stressed that the increasing number of automobiles will eventually reverse the downward trend in mobile source emissions nationwide unless more stringent tailpipe standards are adopted.

EPA respondents were sharply divided over the effectiveness of regulatory measures intended to offset new stationary source emissions. Only ‘major’ and commitment to solve the problem. They suggested that EPA “dragged its feet” on decisions to issue Federal regulations for fuel volatility, automobile refueling emission controls, and more stringent tailpipe standards. Participants suggested that EPA’s indecision discouraged States from developing their own regulations for those particular sources or for other categories that would deliver small benefits in comparison. As discussed above, the States argued that they were often unable to promulgate additional stationary source regulations because EPA stopped issuing CTGs.

new sources, those that emit more than 100 tons per year, have been subject to new source review, which requires them to obtain emissions reductions from existing sources to offset their emissions, and to install the most stringent control technology available. New sources larger than 100 tons per year can avoid new source review by obtaining offsetting reductions to limit the net emissions increase to less than that of a “major” source, a practice called “netting.” About half of EPA respondents felt that too many sources have been exempt from new source review. However, others suggested that current new source review adequately counteracts emissions growth or results in only insignificant emissions increases.

Most State and local workshop participants were dissatisfied with new stationary source controls. They distrust emissions trading, since they feel that most emissions reductions used in “netting” or offsets would have occurred anyway. State participants argued that such reductions should have been “credited toward cleaner air” rather than used to facilitate new emissions.

Inability To Control “Transported” Ozone and Precursors

State and local participants complained about the difficulty of achieving adequate emissions reductions when the geographic characteristics of the problem do not correspond to State boundaries. State

and local respondents suggested that many nonattainment areas monitor high levels of ozone precursors and even nonattainment levels of ozone in air masses entering their areas. They argued that emissions in upwind attainment and nonattainment areas contribute significantly to some cities’ air quality problems and to elevated ozone levels in rural areas. EPA respondents also ranked transport as a serious problem, although they did not rank it as highly as did State respondents.

Lack of Leadership and Political Will To Solve the Problem

In response to these criticisms, EPA respondents suggested several areas in which the States did not require the measures that they should have, citing inadequate automobile inspection and maintenance programs and incomplete SIP implementation as examples. Although they acknowledged that some Federal regulations have been delayed, most EPA respondents suggested that earlier issuance of those regulations would not have had a large effect on the overall nonattainment problem.

The GAO report concluded that both State implementation and enforcement of control programs and EPA oversight have not been as effective as they should have been. From their discussions with State and local officials, the GAO investigators concluded that at the local level there has been “a general reluctance to implement control measures that will have a negative impact on economic development or change lifestyles” [5]. Agreeing with comments made by EPA participants at our workshops, GAO

pointed out a number of specific examples of weak implementation, inspection, and enforcement at the State and local level.

Although the Act delegates primary responsibility for developing SIPs and promulgating the necessary regulations to the States, EPA is responsible for reviewing SIPs and overseeing their implementation. The GAO report was critical of EPA's oversight role. In two of the three urban areas they studied, EPA did not enforce requirements that the States stick to their declared schedules of annual emissions reductions. All three areas had problems with their SIPs. Even though EPA was aware of deficiencies, it did not call for SIP revisions in two of the areas and waited until July 1987 to disapprove the SIP submitted by the third area.

EPA participants at our workshops agreed with many of the criticisms of EPA's performance, but stated that they faced serious constraints on their ability to administer the Act. Questionnaire respondents cited inadequate budgets, OMB interference, and lack of political support. Some suggested that there was never really the "political will" to take the steps necessary to solve the ozone problem. Although many EPA participants cited "lack of political will" as a problem, they disagreed over whose will was lacking. Some suggested that there was an implicit understanding between the States and EPA not to push for more aggressive control measures since they felt that they had reached the limits of public acceptability. Others suggested that past efforts were not at all aggressive; *administrative* will, not public support, was lacking. Some argued that the change in Administration in 1981 led to weaker EPA implementation of the Clean Air Act.

Unreasonable Deadlines

Finally, many EPA respondents suggested that the deadlines Congress specified in the 1977 Amendments were simply unreasonable. They argued that widespread failure to attain the standard by December 31, 1987, does not reflect insufficient progress as much as unrealistic expectations. While some suggested that the deadline was only unreasonable for Los Angeles, others felt that it was unrealistic for many areas. Participants at both workshops argued that unreasonable deadlines were counterproductive. They suggested that overly stringent deadlines encouraged States to cheat on their SIPs and EPA to play along with them.

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