Chapter 8

Policy Options

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INTRODUCTION

More than 10 years have gone by since the passage of the last major set of amendments to the Clean Air Act. While some progress has been made in reducing VOC emissions and lowering ozone concentrations, most major metropolitan areas still do not meet the ozone standard. Ozone has been the most difficult of the major air pollutants to control over the almost 20-year history of the Clean Air Act. The Nation has failed several times to meet the attainment deadlines set by Congress in the Clean Air Act-first in 1975 and again in 1982 and 1987.

One of the most important findings of our assessment is that about half of the nonattainment cities will still not be able to attain the standard with currently available VOC control measures. According to our calculations, most areas with peak ozone concentrations above 0.16 ppm will not be able to attain the standard with existing VOC controls. Some areas with even lower peak concentrations may have great difficulty, as well. These include: cities that are heavily affected by pollution transported from neighboring areas, cities that have already implemented most of the available VOC control measures, and cities where ozone levels are more sensitive to NO_x emissions, for example, southern cities that are surrounded by areas with high emissions of VOCs from natural sources.

If Congress once again sets ambitious near-term targets for the next decade, *but ignores the decade that follows, we* will likely fail one more time. An effective ozone strategy must incorporate two components: 1) measures to address near-term VOC reductions possible with currently available control methods and 2) measures to ensure that we can continue to make progress after the year 2000, when many areas will still exceed the standard even after substantial emissions reductions are made in the next 5 to 10 years.

In this final chapter, we present options for Congress in three broad categories. First we present options for **overall requirements,** including *deadlines* for attaining the standard; *interim requirements* to ensure continuing progress towards attainment; *and penalties* in the event of failure. We also present options for *State planning,* and for further *research.* Table 8-1 outlines these more general policy decisions facing Congress and the options that we present.

We then provide options for the near-term VOC reductions that **are possible using currently available control methods.** Because air pollution control under the Clean Air Act relies on a partnership between EPA and the States, these fall naturally into two categories: a list of *federally implemented, nationwide control requirements* and *control requirements to be implemented by the States.* The section concludes with options for *managing emissions growth* in nonattainment areas. An outline of these options is found in table 8-2.

Because many areas will not be able to attain the ozone standard by relying solely on currently available VOC control measures, we discuss some new directions for the Clean **Air Act** in the final section. These include controls on *nitrogen oxides in nonattainment areas,* controls on both *nitrogen oxides and VOCs in upwind areas,* and several alternatives for *long-term strategies* for the worst nonattainment areas. We also present options for *lowering ozone concentrations in rural areas* to protect crops and forests. Table 8-3 summarizes the options discussed in this final section.

OVERALL REQUIREMENTS

Deadlines

Discussion

The 1977 Amendments established two major categories of nonattainment areas, each with its own attainment deadline. Areas with less severe problems were to attain the standard within 5 years, by the end of 1982. Those areas that could not attain the standard by the end of 1982 by adopting all reasonably available control measures were given an additional 5 years. However, by December 1987, the deadline for all areas to attain the standard, more than 60 areas were still not in compliance.

Congress is once again faced with the problem of setting new deadlines. An important finding of our

Table 8-l-Options for Amending the Clean Air Act: *Overall Requirements*

Deadlines:

Decision 1: How many categories of nonattainment areas, each with its own deadline and other requirements, should be established?
- Option 1: Two categories-those that can attain the standard with currently available controls and those that cannot.
- Option 2: Three or more categories, including more than one category of areas that cannot attain with currently available controls.

Decision 2: What deadline should be set for those areas that can attain the standard with currently available control methods?
- Option 1: Maintain the Act's current 5-year schedule from start of planning to attainment.
- Option 2: Require detailed inventories, modeling, and planning and allow 5 to 7 years.

Decision 3: What deadline(s) should be set for those areas that cannot attain the standard with currently available control methods?
- Option 1: 8 to 10 years for the "best" of the areas that cannot attain with currently available control measures; at least 20 years for the '(worst" (Los Angeles).
- Option 2: Eliminate deadlines.

Interim Requirements:

Decision: What interim requirements are needed to ensure continuing progress towards attainment?
- Option 1: Interim air quality targets.
- Option 2: Areawide emission reduction schedules.
- Option 3: Source-specific controls.
- Option 4: Some combination of the above options.

Penalties and corrective actions in the event of failure:

Decision 1: For what kinds of failures should States be penalized?
- Option 1: Sanctions for failing to make "sufficient" efforts.
- Option *2:* Sanctions for failing to identify enough controls to meet a congressionally specified reduction schedule.
- Option 3: Sanctions for failing to attain the standard by the required date or to meet an interim requirement.

Decision 2: What types of sanctions should be adopted?
- **Option 1: Sanctions that limit** growth in nonattainment areas, for example, a ban on construction of new sources of pollution or a moratorium on hookups to publicly owned drinking water distribution systems or sewage treatment systems.
- Option 2: Limits on Federal assistance, for example, withholding Federal highway funds (except those for safety, mass transit, and transportation improvement projects related to air quality) or sewage treatment grants.

Decision 3: What types of corrective actions should be adopted?
- Option 1: Planning requirements.
- Option 2: Source-specific controls.
- Option 3: Market-based control programs, for example, emissions fees or marketable emissions permits.

State and local planning requirements:

Decision 1: What types of planning should be required and where?
- Option 1: Minimal requirements for all nonattainment areas.
- Option 2: Enhanced efforts in areas with the worst ozone problems or atypical conditions.

Decision 2: Who pays for enhanced State and local planning activities?
- Option 1: Increase funding for section 105 grants or make special, separate appropriations for ozone nonattainment area planning.
- Option 2: Develop a nationwide user-fee program (administered by EPA) or a fee requirement (administered by the States) on nonattainment area emissions.

Research:

Decision 1: What areas of research deserve increased funding?
- Improving the planning process, developing new control methods, and further evaluating the risks from ozone.

Decision 2: Who **pays for the research?**
- **Option 1: General revenues.**
- **Option 2: User fees.**

SOURCE: Office of Technology Assessment, 1989.

assessment is that many areas will not be able to attain the standard with the adoption of "currently available" control methods.[1] Thus when considering potential attainment deadlines, Congress must once again address two separate questions:

- What is an appropriate deadline for those areas that are now close enough to meeting the standard that they can do so using currently available control methods?
- What is an appropriate deadline or set of deadlines for areas that cannot meet the standard with currently available control methods?

Both EPA and STAPPA/ALAPCO (the State and Territorial Air Program Administrators, which represents State-level air pollution regulators, and the Association of Local Air Pollution Program Administrators, representing local regulators) have stated that about 5 years is an appropriate timeframe for areas that can meet the standard with currently

[1] These are control methods that are well enough understood that we are able to estimate their emission reduction potential and costs. While we are certain that some additional controls are possible, we believe that the large majority of VOC emissions reductions possible with currently available control methods are accounted for in our analysis.

Table 8-2—Options for Amending the Clean Air Act: *Currently Available Control Methods*

Federally implemented, nationwide control requirements:
- Option 1: Limits on gasoline volatility.
- Option 2: More stringent tailpipe exhaust standards for cars and trucks.
- Option 3: "Onboard" technology for cars and trucks to control refueling emissions.
- Option 4: Federal solvent regulations, for example, for architectural coatings.

Control requirements to be implemented by States in nonattainment areas:
- Option 1: Lowered source-size cutoff for requiring "reasonably available control technology" (RACT).
- Option 2: Require EPA to define RACT for additional source categories.
- Option 3: More stringent requirements for motor vehicle inspection and maintenance programs.
- Option 4: Required use of alternative fuels by centrally owned fleets.
- Option 5: Transportation control measures.
- Option 6: Tax on gasoline.

Managing growth:
- Option 1: Lower the cutoff for new source control requirements.
- Option 2: Eliminate "netting" out of new source control requirements.
- Option 3: Areawide emission ceilings.

SOURCE: Office of Technology Assessment, 1989.

Table 8-3-Options for Amending the Clean Air Act: New *Directions*

Controls on emissions of nitrogen oxides in nonattainment areas:
- Option 1: Congressionally mandated NO_x controls.
- Option 2: Presumptive NO_x controls on stationary sources, with EPA authority to exempt areas under specified situations
- Option 3: Requirements to analyze NO_x controls under certain situations.

Controls in upwind areas:
- Option 1: Enlarge nonattainment areas to include the entire extended metropolitan area.
- Option 2: Congressionally specified NO_x controls in designated "transport regions" or nationwide.
- Option 3: Strengthen the interstate transport provisions of the Clean Air Act.
- Option 4: Provide EPA with clear authority to develop regional control strategies based on regional-scale modeling.

Reducing ozone in attainment (rural) areas:
- Option 1: Specify a deadline for EPA reconsideration of the ozone secondary standard and a schedule for Option by the States.
- Option 2: Congressionally specified NO_x controls.

Long-term VOC control strategies:
- Option 1: Lowering emissions from solvents, either through traditional engineering approaches or through market-based mechanisms.
- Option 2: Transportation control measures.
- Option 3: Requirements for widespread use of alternative fuels in nonattainment areas that are far from meeting the standard.

SOURCE: Office of Technology Assessment, 1989.

available control measures to both plan and implement emissions reductions [15,22]. For those areas where currently available controls will not be sufficient, EPA has proposed to require a 3 percent per year reduction in VOC emissions. Under the resulting schedule, some of the worst areas might take over 20 years to attain the standard.

When addressing the question of timing, there are several factors that Congress might wish to consider. First, sufficient time must be allowed for planning and other administrative requirements under the Clean Air Act. The amount of time Congress allowed for planning in the 1977 Amendments turned out to be about half the time required. Once controls are mandated, sufficient time must be allowed for them to be implemented. For those areas that cannot meet the standard with currently available measures, Congress must allow time for new methods to be developed. Finally, Congress must weigh the urgency of the problem against the difficulty of the task. Allowing more time for development and implementation of control measures might reduce their cost or facilitate their acceptance. However, allowing more time also means that more people will be exposed to concentrations above the standard. Each of these factors is discussed in greater detail below.

Factors to Consider When Choosing Deadlines

How Much Administrative Lead Time Is Necessary?—History is probably the best guide to the amount of time required to complete the process of State planning for emissions reductions and for subsequent EPA approval. Under the 1977 Clean Air Act Amendments, EPA was to identify and list nonattainment areas by early 1978. The States had to revise plans for each of their nonattainment areas and submit SIPS to EPA by January 1, 1979, about 16 months after enactment. EPA was required to approve or disapprove these plans by June 30, 1979, 6 months after the States submitted them.

EPA and the States did not succeed in meeting many of the deadlines established in the 1977 Amendments. By April 1980, 15 months after they were due, SIPS had been submitted for only about 20 percent of the areas. Half of these were either incomplete or considered deficient by EPA [9]. This failure to have SIPs developed and approved in the time allotted continued through the 1980s.

Table 8-4 displays the SIP actions required of the States and EPA, and compares the amount of time allowed by Congress in the 1977 Amendments with the amount of time it actually took to complete these actions. As the table shows, the time frame specified by Congress was substantially exceeded by the States and EPA, Rather than taking a little under 2 years from enactment to approval or disapproval of a SIP, as required under the 1977 Amendments, the entire process took about 3 to 4½ years.

Three years seems to be a reasonable allowance for the time needed between EPA's call for revision of a SIP to EPA approval, assuming the type of planning undertaken is similar to that followed under the 1977 Amendments. An extra year or two should be added if more detailed inventorying, modeling, and planning are required. The advantages and disadvantages of enhanced planning requirements are discussed in a later section.

How Quickly Can Emissions Be Lowered?— Once the planning process is complete, time must be allowed for controls to be implemented. For control methods that are well understood and can be applied to existing sources, a year or two could be sufficient. For example, the San Francisco Bay Area Air Quality Management District allowed gas stations 7 months to install devices to capture gasoline vapors lost during refueling. Large drycleaners were given 21 months to install control devices, once regulations were issued. Smaller facilities were given an additional 1 or 2 years. Most available controls fall into this category-of the emissions reductions we were able to identify, about 35 percent are available now and could be implemented and effective within a few years.

Other controls, however, require a much longer lead time. Lowered exhaust emission standards for

Table 8-4—Time Requirements for SIP Process Under the 1977 Clean Air Act Amendments

Action	Required time	Actual time	Difference
1. Designation of a State's attainment status	6 months (from promulgation of Amendments)	8 months	2 months
2. States' development of technical database		3 to 6 months minimum 15 to 24 months maximum[a]	
3. State submission of revised SIP (development of new ozone control strategy and adoption of regulations by State or local agency)	By January 1, 1979 (10 months from attainment designation)	19 to 33 months[b c d]	9 to 23 months
4. EPA review and approval or disapproval of **SIP**	Act allows 6 months between date SIPS were due (1/79) and date construction ban was to have been imposed (6/79)	9 to 24 months[b e]	3 to 18 months
Total time	22 months (1.8 years)	36 to 53 months (3.0 to 4.4 years)	14 to 43 months (1.2 to 3.6 years)

*"Study of the 1979 State Implementation Plan Submittals: An overview of the SIP Review Process at the State Level and the SIPS for Particulate Mattar, Sulfur Dioxide and Ozone," Pacific Environmental Services, ho., for the National Commission on Air Quality, December 1980.
[b]Pacific Environmental Services, I,e., *Study of the 1979 State Implementation Plan Submittals* (Washington, DC: National Commission on Air Quality, December 1980).
[c]National Commission on Air Quality, *To Breathe Clean* Air (Washington, DC: March 1981).
[d]Many States started working on SIP revisions as early as 1975 or 1976, about 12 t. 26 months before the 1977 Clean Air Act Amendments. This time was not included In the 19- to 33-month "actual" timeframe *listed for Action #3.*
[e]Comments of participant in OTA "Ozone and the Clean Air Act" workshop, Sept. 30.1987.

SOURCE: Office of Technology Assessment, 1969.

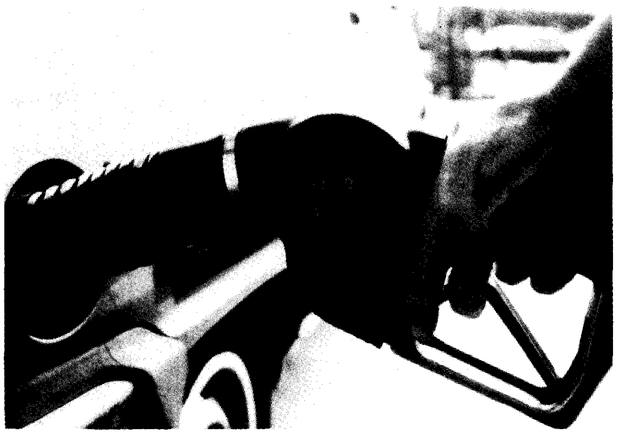


Photo credit: South Coast Air Quality Management Dostroct, El Monte, CA

Stage II control devices installed on service station pump nozzles help control the release of gasoline vapors during motor vehicle refueling, Such devices can be installed and working in under a year from the time regulations are promulgated. Another method of controlling refueling emissions, installing canisters directly "onboard" cars, requires about a decade to take full effect.

new cars require over a decade to take full effect. About 4 years of lead time is needed for manufacturers to bring cars equipped with additional controls to market. After another 5 years, enough new cars will have been purchased so that about half the cars on the road will have the new controls. Replacement of the second half will take even longer.

The greatest uncertainty, of course, surrounds the time needed to develop *new* control methods. For example, close to 20 percent of VOC emissions come from a variety of solvent uses. For many of these uses, reformulated products, substitutions, or process changes might be used to lower emissions. We have no way of anticipating how long it will take to develop these alternatives. The deadlines that Congress sets will certainly influence the rate of development of new control methods, but Congress cannot be assured that any deadline can be met.

***How Urgent is the** Problem?—Human* exposure to ozone primarily affects the lungs. Ozone has been *shown* to cause immediate, short-term changes in lung function and increased respiratory symptoms, and is *suspected* of playing a role in the long-term development of chronic lung diseases. The immediate or ''acute" effects may include some breathing difficulty and coughing, but such effects appear to be reversible, usually disappearing after a few hours.

Although the short-term effects are important, many health professionals appear to be more concerned that repeated exposure to ozone over a lifetime may result in permanent respiratory impairment. Since ozone damages the tissues lining the airways of the lung, ozone could play a role in accelerated aging of the lung, retardation of lung development in children, or the development of pulmonary fibrosis, a chronic lung disease. We are not yet able to confirm or dismiss many of the concerns about these effects.

The Clean Air Act has set a societal goal of achieving air quality necessary "to protect the public health . . . with an adequate margin of safety. " The Administrator of EPA is responsible for setting national ambient air quality standards based on health effects information alone, with no consideration of the difficulty of achieving them. While there is certainly some disagreement about the precise concentration at which the standard should be set, ozone concentrations in many major U.S. cities are well above the range of controversy on at least a few days each year.

Without explicit direction from Congress that avoiding the types of effects described above is no longer a societal goal-and there are few indications that society as a whole feels that this is the case-the ozone standard is unlikely to be relaxed. Rather, since recent studies point to health effects at concentrations *below* the standard when exposure occurs over several hours, if the standard is changed it is likely to be tightened.

However, Congress sets not only the level of protection that the standard is to achieve, but the *date by which it is to be met.* In this latter decision Congress cannot avoid some balancing of the magnitude of the health problem with the costs and difficulty of achieving the standard. At issue is *not* just how quickly areas must install well-understood control technology, but also how quickly new technology can be developed and whether too short a schedule will result in wasted resources or less efficient or socially acceptable control methods. An understanding of how many people are affected by ozone, and how seriously they are affected, can help with this decision.

No doubt, most Members and staff have heard many conflicting statements about the seriousness of the ozone problem. Some people have characterized it as a problem that affects a few asthmatic joggers who do not have the good sense to avoid running on a few hot, smoggy afternoons each year. Others state that it is a major public health problem adversely affecting over 100 million Americans.

While it is true that over 100 million people live in U.S. cities that do not meet the ozone standard, not everyone is in the right place at the right time to be exposed to concentrations above the standard. Taking into account when and where people are outdoors, we estimate that about 25 percent of people who live in these cities are actually exposed to ozone concentrations above the standard. Even then, ozone is thought to be a problem primarily when people are exercising. We estimate that about 20 million people are exposed to concentrations above the standard while exercising at moderate levels of exertion and that on average, these people are exposed about 9 hours per year. Of course, the number of hours of exposure varies considerably by region.

In chapter 3, we attempt to quantify many of the health improvements one can expect from lowering ozone levels. We estimate that if ozone concentrations were lowered enough to meet the standard in all areas, about 110 to 350 million cough incidents each year, and about 60 to 200 million incidents each of shortness of breath and chest pain, might be avoided each year. About 8 to 50 million "restricted activity days" might also be eliminated. These are days when someone feels ill enough to disrupt most of the day's activities, but generally not to spend the day in bed or stay home from work. About 2 million days of asthma attacks would also be eliminated.

These health benefits become more meaningful when expressed on a per person basis. For example, among every 100 people, averaged across all nonattainment areas, meeting the standard would eliminate about 100 to 300 cough episodes per year. However, the average improvement varies considerably from nonattainment area to nonattainment area, depending on the severity of the ozone problem. In those areas where peak ozone concentrations are close to the standard (between 0.12 and 0.14 ppm), meeting the standard would eliminate about 15 to 55 cough episodes per year and about 3 days of restricted activity among every 100 people. In those areas with the worst ozone problems, meeting the standard would eliminate 400 to 1,400 cough episodes per year and about 120 days of restricted activity, among every 100 people.

Unfortunately, we cannot similarly add up the longer term, chronic effects of exposure to ozone that would be avoided if ozone levels were lowered. Whether there are chronic effects from exposure over many years and, if so, their magnitude, is still unknown. This too, must be factored into the congressional decision on setting attainment deadlines.

Options

Decision 1: How many categories of nonattainment areas and associated deadlines should be established?

Option 1: Two categories.

At a minimum, Congress must establish two categories of nonattainment areas, recognizing that while many areas will be able to attain the standard with currently available control methods, many will not. Congress could directly specify the dividing line, for example, based on each area's "design value" (a measure of peak ozone concentrations), which is a reasonable predictor of the reductions necessary to attain the standard. OTA estimates that the dividing line falls somewhere between design values of 0.15 and 0.16 ppm, that is, most cities with design values of 0.16 ppm or greater will not be able to attain the standard with currently available VOC control methods. Alternatively, Congress could require EPA to make a determination of the likelihood of each area being able to attain the standard using known control methods.

Option 2: Three or more categories.

Congress may want to divide nonattainment areas that cannot attain the standard with known technology into three or more categories, based on the severity of the problem.

Decision 2: What deadline should be set for those areas that can attain the standard with currently available control methods?

Option 1: Maintain the Act's current 5 year schedule from start of planning to attainment.

Under the 1977 Clean Air Act Amendments, Congress allowed 5 years for those areas that were able to meet the standard with the "application of reasonably available control measures. " Though many areas took longer than 5 years to achieve the reductions specified in their SIPS, the timeframe seems reasonable, assuming that the planning process remains about as complex as is currently required. As mentioned above, both EPA and STAPPA/LAPCO, the associations of State and local air program administrators, have proposed timeframes of about 5 years.

Option 2: Require detailed inventories, modeling and planning and allow 5 to 7 years.

Allowing additional time for detailed inventories, modeling and planning will help identify those areas that at first might appear to be able to meet the standard by applying currently available technology, but because of atypical conditions (e.g., areas with unusually predominant sources of one type or significant emissions from vegetation) will need to identify additional VOC controls, controls in upwind areas, or possibly undertake NO_x reductions. While a simpler planning process will be adequate for many nonattainment areas with low design values, the simpler process can yield overly optimistic results in some atypical nonattainment areas.

In those areas that actually can meet the standard using currently available controls, allowing additional time for detailed planning and modeling might prevent some overcontrol in some areas or identify more cost-effective emissions reductions. The disadvantage of such an approach is that ozone concentrations could remain high longer. The benefits and costs of detailed planning exercises are discussed in a later section of this chapter.

Decision 3: What deadline(s) should be set for those areas that cannot attain the standard with currently available control methods?

Under the 1977 Amendments, Congress chose 10 years as the appropriate timeframe for meeting the standard in those nonattainment areas that could not do so with control measures "reasonably available" in 1977. Assuming appropriate incentives exist so that new control methods will be developed, the additional 5 years over and above the time needed for basic planning and implementation should allow some areas to attain the standard. However, in many areas the shortfall between emissions reductions needed and currently available is so large that considerably longer time may be needed. For example, the Los Angeles region, the worst nonattainment area in the country, anticipates that at least 20 years are needed to develop and implement the control measures necessary for it to attain the standard.

Option 1:8 to 10 years for the "best" of the areas that cannot attain with currently available control measures; at least 20 years for the "worst."

The amount of time necessary to develop new control methods is simply not known. Shorter time frames might be achieved with additional Federal R&D funds (discussed in a later section) and careful attention to the penalties of missing the deadline. The very real possibility of missing these deadlines must be accepted, however.

Option 2: Eliminate deadlines.

In its 1981 report, the National Commission on Air Quality (established by Congress under the 1977 Clean Air Act Amendments to analyze strategies for achieving the goals of the Act) recommended that deadlines be eliminated. In their place, they recommended a technology driven process. Every 3 years, EPA would identify additional reasonably available control technologies. Remaining nonattainment areas would be required to adopt those controls or measures that would lead to equivalent reductions.

The advantages and disadvantages of available substitutes for deadlines are discussed below under the section on "Interim Requirements. "

Interim Requirements

Discussion

As described above, the 1977 Clean Air Act Amendments required nonattainment areas to attain the standard within 5 or 10 years. Though the Amendments also included some requirements for annual increments of emissions reductions, in practice, this requirement seems to have had little effect. There were few Federal requirements that the States had to meet between the time plans were submitted and the eventual 5- or 10-year deadline.

Many of the recent proposals to amend the Act have specified "interim" requirements. Because many of the proposals would allow more time to meet the standard than the 1977 Amendments, the need for some type of interim milestone is greater.

There are two distinct purposes for interim requirements: 1) to establish the minimum level of effort towards attaining the standard and 2) to establish a mechanism for tracking progress and taking early corrective action. Both the form of the interim requirements and the types of sanctions applied for failure to meet them depend on which of these two goals one is trying to achieve.

Congress could choose among three types of interim requirements: 1) air quality targets, for example, lowering ozone concentrations half of the way between current levels and the standard by a specified date, 2) areawide emission reduction requirements, for example, requiring a 10 or 15 percent reduction in VOC emissions every 3 years, and 3) source-specific technology or performance standards. The advantages and disadvantages of the three approaches are discussed below.

Options

Option I: Interim air quality targets.

Rather than setting only one air quality target—attaining the standard by a specified date—Congress could establish one or more additional air quality levels that must be met by earlier dates. These might be specified in the same form as the standard-i. e., peak concentrations must be lower than a specified target—or by using a different indicator of air quality, for example, number of exceedances of the standard each year.

Air quality measurements are the most direct way to determine whether progress is being made towards meeting the goal of the Act. If fewer exceedances of the standard or lower peak ozone concentrations are measured—and enough years have been averaged to have overcome year-to-year climatic variability—one can be confident that an increment of progress has been made. Uncertainties about emissions inventories, air quality models, and implementation effectiveness are all avoided.

Unfortunately, feedback about whether progress is being made can be delayed by several years. Several years of monitoring data must be averaged to be assured that the progress observed is not due to a somewhat cooler summer or similar, natural fluctuation. It may be possible to correct for such variation, but the approach would lose some of its attractiveness-its direct relationship to what is measured at an air quality monitor.

If one of the purposes of adopting an interim requirement is to have a yard stick against which to judge each State's performance-and penalize those that are not moving quickly enough—an air quality target may be an inappropriate choice. Success meeting the target depends on efforts of both State and Federal regulators and an accurate understanding of the science of ozone formation. Thus some feel it is unfair to penalize a State in the event of failure to meet the target if the fault is not clearly identified as the State's.

However, if the purpose for adopting an interim requirement is to identify that something is not working as planned and to signal the need for an examination of the cause of failure, an air quality target is highly appropriate. Thus rather than linking a failure to achieve the target to a sanction, Congress might consider linking it to a requirement to reopen the planning process.

Option 2: Areawide emission reduction schedules.

A second option for an interim requirement is a schedule of areawide total emission reductions. In 1977, Congress added a provision to the Act that required areas to achieve "annual incremental reductions in emissions . . . sufficient in the judgment of the Administrator" to attain the standard within 5 or 10 years. A somewhat different approach has been proposed by both EPA and several bills introduced in the 100th Congress. Directly specified rates of progress—3 percent to 5 percent per year, depending on the proposal-are required of most areas. Rather than "back calculating" the rate of progress needed to attain the standard by a specified date, the new proposals opt for a rate of progress based on a judgment of a reasonable rate to implement (and in many cases, both develop and implement) new emission controls.

One of the reasons for the popularity of this approach is that it is not affected by the uncertainties inherent to modeling future air quality. States are given an identifiable target over which they feel they have direct control. Success or failure to meet the target is judged by whether the State achieved the reductions stated in their plan, not whether the air quality model used in the plan proves to be scientifically accurate.

Moreover, the approach retains considerable flexibility for the States. Assuming enough control alternatives exist for a State to have a choice, source categories that might be particularly difficult or expensive to control in a given nonattainment city could be left alone. This type of requirement is well suited to a market-based approach to reducing emissions, should Congress or the States decide to adopt one.

There are, however, some disadvantages to this approach, as well. Some State agencies may not have sufficient expertise to design the regulations needed to meet their emission reduction schedule. Others may not have the political clout necessary to require the new regulations. For such States, a list of federally prescribed regulations would be preferable.

In addition, emissions inventories can be "gamed," that is, reductions can be exaggerated by using overly optimistic assumptions about the level of control actually achieved. Gaming of SIPS submitted after the Clean Air Act Amendments of 1977 is often given as one reason for the failure of some areas to achieve the reductions they needed to attain the standard.

Option 3: Source-specific controls.

A third option for an interim requirement is for Congress to directly specify controls for specific source categories, and to direct the Administrator of EPA to issue appropriate regulations. States would be required to adopt the specified controls, for example, inspection and maintenance programs for motor vehicles, by a specified date.

STAPPA/ALAPCO, the associations of State and local air pollution regulators, is one of the foremost advocates of this approach. Federal assignment of the source categories that must control their emissions and the degree of control removes the burden of making these assignments from the States. This would be most helpful in those States with minimal expertise in designing regulations and in States where legislatures have been hesitant to approve regulations not specifically required by EPA. In addition, under this option, States know **exactly** what they are required to do. Failures to achieve the interim target are relatively easy for EPA to identify, and clearly the responsibility of the State, not the fault of a modeling error.

Industry often prefers this approach as well, especially if the control requirements are specified by EPA through agency rule-making rather than directly by Congress. The rule-making process provides greater protection that the controls are feasible.

From another point of view, however, this approach imposes a very large burden on EPA to come up with new methods of lowering emissions. There are no incentives for industry to actively develop new control methods, as there would be if they were required to meet a progressively tightened schedule of emissions reductions.

Possible candidates for congressionally specified controls are included in a later section, "Control Requirements."

Option 4: Some combination of the above options:

Congress might choose to combine some or all of the interim requirements discussed above to take advantage of the strengths of each. For example, Congress might require several particularly cost-effective, source-specific controls to be implemented by an early date. A congressionally specified percentage reduction in emissions might apply until attainment. For the worst nonattainment areas, Congress might also add an interim air quality target, to keep the program firmly linked to identifiable improvements in air quality.

Table 8-5-Sanctions for Failure To Meet the Requirements of the Clean Air Act

1. **For failure of a state to submit inadequate SIP by the required date:**
   a. Section 110 requires the Administrator of EPA to prohibit the construction of major stationary sources in nonattainment areas if a SIP revision is inadequate.
   b. Section 176(a) requires the EPA Administrator to withhold Federal highway funds, except those for safety, mass transit, and transportation improvement projects related to air quality. EPA interprets this sanction to be dependent upon a discretionary finding by the Administrator that an area both failed to submit and failed to make a reasonable effort to submit a plan meeting Part D requirements. Under this interpretation, an area which made a reasonable effort to submit a plan by the deadline but failed to do so would not have its highway funds withheld. EPA's interpretation was recently upheld in Court.[a]
2. **For failure of a State or local area to adequately implement their SIP:**
   a. Section 176(b) enables the EPA Administrator to halt Federal air program grants. EPA has interpreted this sanction to apply only to areas that it "finds" not to have implemented requirements under its SIP. Without this formal finding by EPA, the Agency believes it has the discretion not to impose this sanction. Others disagree, however, and believe this sanction to be nondiscretionary.
   b. Section 316 allows the EPA Administrator discretion to withhold, condition, or restrict Federal grants for sewage treatment plant construction.
3. For **failure to attain the standard by the required date:**
   Section lo requires the Administrator of EPA to prohibit the construction of major stationary sources. There is some difference of interpretation with regard to this sanction. Some believe that a construction moratorium should be imposed if a State fails to meet the standard by the deadline. EPA believes that the sanction should not apply to areas with *approved* plans that *predicted* attainment by the deadline but failed to actually attain the standard by the deadline.

[a]*McCarthy* v. *Thomas*, District Court, Arizona, Aug. 10, 1987.

SOURCE: Office of Technology Assessment, 1989.

Penalties and Corrective Actions in the Event of Failure

Discussion

The Clean Air Act includes a series of sanctions for the EPA Administrator to impose on States if certain requirements are not met. As detailed in table 8-5, the Act includes different penalties for failing to submit a revised plan for how each nonattainment area intends to lower emissions, penalties for failing to implement the requirements of the plan, and penalties for failing to attain the standard by the required date.

Few would disagree that some type of penalty is appropriate for failing to submit a revised plan or for adequately implementing that plan. At issue is whether a State should be penalized for failures that are in some ways beyond its control. For example, if Congress sets a 10-year deadline for an area that needs greater emissions reductions than current control methods can provide, should the area be penalized for not being able to find as-yet-undeveloped control methods to meet the standard?

Congress must match appropriate penalties or corrective actions to the different types of possible failures. When considering what types of sanctions are appropriate to impose on States, it is helpful to understand the possible causes of failure. These include:

1. Failure that is primarily the fault of the State, including poor planning, implementation, and enforcement.
2. Failure that is due to reasonable scientific or technical errors, for example, uncertainties inherent in air quality modeling.
3. Failure due primarily to poor EPA performance.
4. Failure to maintain a congressionally specified reduction schedule or attain by the deadline because progress in developing new control methods turn out to be slower than hoped for.

Again, sanctions such as those included in the current Act may be appropriate for the first type of failure-those primarily the fault of the State. But many consider it unfair to sanction the State for failures due to poor scientific understanding. Corrective actions may be more appropriate for those failures that are beyond a State's control. Such corrective actions might include instructions to revise implementation plans or requirements to adopt source-specific controls that previously were left to the State's discretion.

Options

Decision 1: For what kinds of failures should States be penalized?

Congress may wish to penalize the States for only certain types of failures. The options listed below **are not** mutually exclusive.

Option 1: Sanctions for failing to make "sufficient" efforts.

Few would disagree that penalties are appropriate for States that violate requirements of the Act over which they have complete control. For example, States should be required to submit revised SIPS by a reasonable date and implement and enforce the control measures included in their plan.

Option 2: Sanctions for failing to identifiy enough controls to meet a congressionally specified reduction schedule.

Congress faces a difficult choice deciding whether to penalize areas that *need* greater emissions reductions than can be expected from currently available control methods. These areas cannot specify the details of their plan to attain the standard by the required date or how they will meet interim reduction requirements.

If Congress decides not to penalize States for these failures, it must provide some guidance to EPA about what should be considered an available control method. Congress must indicate whether the dividing line should be "reasonably available" control methods, "lowest achievable" emission rates, or some similar descriptor of what constitutes a "sufficient" effort on the States' part.

Arguments against imposing sanctions for failure to identifiy enough controls center on concerns for fairness. Should States be penalized for the limits of current technology? Arguments for imposing sanctions under these conditions rest on the idea behind "technology forcing" requirements. How can one expect to rapidly develop new technology if there are no incentives to do so?

Option 3: Sanctions for failing to attain the standard by the required date.

Last, Congress must decide whether States should be penalized for not meeting their attainment deadline, even if they meet all other requirements of the Act. States that have fulfilled all the requirements of their plans might still fail to attain the standard due to uncertainty inherent in predicting future air quality or to failures on EPA's part. STAPPA-ALAPCO, in particular, has objected to penalizing States for failing to attain by a specified date.

Arguments against imposing sanctions for failure to attain the standard again center on concerns for fairness. Should States be penalized for failures beyond their control? Others argue that deadlines without sanctions will not be taken seriously.

Decision 2: What types of sanctions should be adopted?

Option 1: Sanctions that limit growth in nonattainment areas.

The current Act includes as one of its sanctions a ban on the construction of major stationary sources (sources that have the potential to emit greater than 100 tons per year). In a series of workshops held by OTA, there was general agreement that in low- or no-growth areas, the construction ban has had little effect. One of the participants noted that a construction ban has been in effect in Chicago for over five years, but ''no one cares". As a remedy, some have suggested lowering the threshold to 50 tons per year or lower.

However the construction ban, or a variant, might be quite influential in areas experiencing higher growth. One participant at our workshops commented that the Michigan State legislature did not improve an automobile inspection and maintenance program until auto manufacturers complained that they could not construct new facilities under the construction ban.

Variants on a construction ban might be almost as effective, but allow a bit more flexibility. Rather than imposing an outright construction ban, new sources would be allowed to locate only if they offset their emissions with 2, 5 or more times the emissions reductions at existing facilities. After additional controls have been imposed, however, obtaining the necessary offsets should in theory be extremely difficult and available only for priority projects.

Recent congressional proposals have also included two additional types of sanctions that would serve to limit growth in nonattainment areas. These include a proposal for a moratorium on hookups to publicly owned drinking water distribution systems and a somewhat similar proposal for a moratorium on hookups to publicly owned sewage treatment systems.

Of course, sanctions that limit growth can have undesirable economic consequences if they have to be imposed. One participant at our workshops noted that for a sanction to be effective, nonattainment areas must believe that EPA and the Congress will be willing to impose the sanction if need be. Thus, as discussed above, Congress must consider what types of failures merit sanctions that limit growth, and whether it will allow them to actually be imposed. When EPA was considering implementing construction bans against 144 nonattainment areas in 1983, Congress added a provision to an appropriations bill to prohibit EPA from imposing sanctions during fiscal year 1984 [23].

Option 2: Limits on Federal assistance.

The Clean Air Act allows the EPA Administrator to withhold three types of Federal assistance: 1) Federal highway funds, except those for safety, mass transit, and transportation improvement projects related to air quality, 2) sewage treatment grants, and 3) grants to State air pollution control agencies.

Some have questioned the wisdom of the last of these provisions. An under-funded agency is less able to remedy the failure that led to the imposition of sanctions.

Decision 3: What types of corrective actions should be adopted?

For failures to meet certain types of interim requirements, corrective actions may be more appropriate than sanctions. Requirements for additional source-specific controls or further planning can serve, in part, as incentives not to fail, but more importantly, can help remedy the failure before the attainment deadline has once again passed. A discussion of the types of interim requirements Congress might adopt can be found earlier in this chapter.

Option I: Planning requirements.

If Congress chooses to adopt interim air quality requirements, Congress could require States that fall behind their schedules to reexamine the premises behind their SIP. States could be required to redo their emissions inventory, collect additional air quality information, or undertake a detailed modeling exercise to understand the reasons for the failure. The details of such a program are discussed below.

Option 2: Source-specific controls.

For areas that fall behind interim emission reduction schedules, Congress may choose to require additional source-specific controls that otherwise might be optional. Several of the proposals of the 100th Congress adopted this approach. Areas that cannot meet their deadlines are reclassified to a category that has more federally prescribed controls.

Option 3: Market-based control programs.

Another option for areas that fall behind interim reduction schedules is for Congress to require market-based control programs, such as emissions fees or marketable emissions permits. Depending on the stringency of the reduction schedules specified, areas might miss interim milestones because regulators cannot identify additional control measures to require. In such cases, the only alternative may be to provide economic incentives to industry and individuals to identify ways to lower emissions through market-based control programs. Clearly, there are no guarantees that such programs will achieve the desired reduction schedule, but the pace of reductions would most likely quicken.

EPA could be required to develop model regulations for the States to adopt. A program based on emissions fees might include fees on stationary sources larger than a specified size, a gasoline tax to lower highway vehicle usage, and a fee on products containing high solvent content. In a program relying on marketable emissions permits, permits are first distributed to VOC emitters, and then cut back gradually according to a specified schedule. Sources must then figure out ways to lower emissions or purchase permits from other sources on the open market.

State and Local Planning Requirements

Discussion

To fulfill its requirement that by 1987 the ozone standard was to be met everywhere in the country, the 1977 Clean Air Act Amendments relied on the State Implementation Planning (SIP) process, in combination with several mandatory control programs. Under the SIP process, the States were to determine how much they would need to reduce emissions in order to meet the ozone standard, and then set up control programs (including those mandated in the Act) to achieve the required reductions. The information required for this planning process included air quality and meteorological data, an emissions inventory, estimates of growth in emissions, and estimates of reductions that could be achieved through the available control measures.

The SIP approach used last time has been criticized for having depended too much on inaccurate estimates of emissions reduction targets. According to this criticism, many areas failed to meet the ozone standard by the 1987 deadline because they underestimated the amount of control they needed.[2] Errors in projected control requirements stemmed from uncertainties in emissions inventories, under prediction of growth in emissions, inadequate monitoring of ambient NO_x, VOC and ozone concentrations, and limitations of computer models used to estimate needed reductions.

For the next round of control efforts, EPA has proposed [22] to require planning exercises similar to those performed last time, with updated, refined and expanded emissions inventories, slightly expanded air quality monitoring, and some evaluation of the effectiveness of specific control measures.[3] More detailed exercises would be left to the discretion of the States.

Planning activities can help States in several ways. First, when done correctly, they can improve estimates of what level of control will ultimately be needed to meet the standard. In areas where control measures beyond those needed to attain the standard are available, they can identify the most cost-effective control measures and prevent over control. In areas with the worst ozone problems, they can be used to assess whether NO_x emissions should be controlled in addition to VOCs and whether regional control measures might be necessary.

The reliability of such information will depend on the time and resources devoted to refining emissions inventories, monitoring, modeling, and investigating control alternatives. EPA has proposed to allow the States two years to develop, adopt and submit State Implementation Plans, including updated emissions inventories, identification and evaluation of control measures, and air quality modeling to demonstrate attainment [22]. For the worst nonattainment areas, where enhanced planning exercises will be needed, EPA has proposed five years for final SIP submittal (with an interim submittal after two years).

EPA has estimated that nationwide, State and local agencies would need to increase the resources they devote to ozone and carbon monoxide control programs by about 50 percent, or about $40 million, to comply with the proposed new requirements [24]. The additional funds would cover efforts to refine emissions inventories, plan for implementation of complex control measures such as use of alternative fuels, and review the effectiveness of control measures. With the most elaborate planning process likely to be undertaken anywhere, the South Coast Air Quality Management District began work on its new Air Quality Maintenance Plan in June 1987, and expects to spend three years on it. The District budgeted $6.2 million for the first two years of the effort **[6].**

If state-of-the-art air quality models are used to predict the effect of emissions reductions on air quality, costs will be higher. Starting with a special monitoring program, and including a concurrent effort to refine emissions estimates, an urban grid modeling study ‘would typically take one to three years and cost on the order of $500,000 to complete [17,18,26]. In some situations, however, costs could go much higher. For example, the anticipated cost of a four-year air quality study being planned for California’s San Joaquin Valley is $8 to 10 million [4].

Options

Decision 1: What types of planning should be required and where?

[2] As the Clean Air Act was interpreted by EPA, sanctions were to be imposed for failure to submit SIPS that ‘demonstrated attainment” by specified deadlines, and for failure to implement SIPS, but not for failure to attain the standard when an acceptable SIP had been implemented in good faith.

[3] The proposal requires that States submit an updated emissions inventory 12 months after the Agency calls for it, and subsequently update the inventory every three years. Previously, process and emissions data were only required for individual sources emitting more than 100 tons per year, with smaller stationary sources treated as area sources. The requirement for data from individual sources would now be extended to include all sources emitting 10 or more tons per year. As before, the proposal requires that the States usc computer modeling to estimate emissions reductions needed for attainment. States would be allowed to use the widely criticized “Empirical Kinetics Modeling Approach” (EKMA) model, but the more detailed and expensive “Urban Airshed Model” (UAM) is recommended. To monitor each area’s attainment status and provide data for computer modeling, EPA’s proposal recommends that at least five ozone monitors and two collocated NO_x and VOC monitors be operated in each nonattainment area.

Option 1: Minimal requirements for all nonattainrnent areas.

The modest planning exercise proposed by EPA would be beneficial in all nonattainment areas. Air quality monitoring and an updated emissions inventory are necessary whether control measures are identified locally or specified at the Federal level. Modeling is the only way to predict the impact of emissions reductions on air quality, and thus to project (at least roughly) progress toward the ultimate goal of attaining the standard.

Option 2: Enhanced efforts in areas with the worst ozone problems or atypical conditions.

In general, nonattainment areas that have the highest design values or exceedance rates need to abate emissions the most to meet air quality standards. Ultimate control costs are likely to be highest in these areas. Enhanced air quality modeling (with supporting monitoring and emissions inventory refinement) and comprehensive assessment of control options would be particularly useful in these areas to ensure that the controls imposed will be effective, to target the most cost-effective measures first, and to recognize and begin to address shortfalls in needed reductions as early as possible.

In some urban areas, atypical emission sources, meteorology, topography, or geographical location may warrant enhanced air quality modeling or special consideration of certain control options. For example, special efforts might be warranted in areas with significant emissions from vegetation, pollutant transport from outside the area, unusually predominant sources of a specific type, or preliminary indications that NO_x controls might be particularly helpful or harmful.

State-of-the-art air quality models (such as the Urban Airshed Model) are the best means available for predicting the effect of emissions reductions on air quality. They are especially preferred for examining the impacts of reducing NO_x emissions, or the effect of emissions reductions that are unevenly distributed within an area. Application of such models typically requires a short-term but intensive pollution and meteorological monitoring program. New information about the composition of emissions and how they are distributed within the area may also be needed, In many areas, estimates of VOC emissions, especially emissions from area sources, need to be refined if models are to give reliable results.

Enhanced local efforts to identify and evaluate control options would help States design control strategies tailored to local conditions. Such efforts might improve the cost-effectiveness, political viability, and administrative tractability of controls. In many nonattainment areas, exhaustive exploration of potential control measures will be required to identify reductions to attain (or come as close as possible to) the standard. In areas where transportation control measures are needed, State and local agencies involved in transportation and land-use planning, as well as air quality, need to be involved.

As an example, in developing its 1988 Air Quality Maintenance Plan (AQMP), the Los Angeles area South Coast Air Quality Management District attempted to identify "all the potential control measures that could be available by the year 2000. " The District included all currently available control technologies as well as measures ranging from development of non-reactive solvents to "clean" motor vehicle fuels. Major transportation and land-use planning studies were conducted in conjunction with the AQMP.

In chapter 6 we concluded that cities with design values of 0.16 ppm or higher will probably not be able to meet the air quality standard for ozone with currently available VOC control measures. Congress could direct the EPA Administrator to require these areas to carry out a comprehensive analysis of potential control measures.

A design value cutoff of 0.16 ppm would also be appropriate for delineating areas where enhanced modeling is required. However, because of the limited availability of people at EPA or State and local agencies who could perform or oversee enhanced modeling, Congress could allow the Administrator to consolidate efforts across areas, where appropriate (e.g., New York City and parts of Connecticut); exempt cities where enhanced modeling would not be useful due to the impact of upwind areas (e.g., Atlantic City, NJ); or set priorities for the order in which the analyses are completed.

Decision 2: Who pays for enhanced State and local planning activities?

State and local planning activities are supported by general State and local revenues, grants from the Federal Government (authorized under section 105 of the Clean Air Act), and fees assessed by State and local agencies on pollution sources.[4] In addition, private groups have supported special air quality modeling and monitoring studies and assessments of control options that have contributed to official planning efforts.

In 1986, State air agency budgets ranged from $270,000 (Nevada) to $54.8 million (California), with the 50-state average at $4.1 million ($3.1 million excluding California). Of 32 local air agencies reporting, 1986 budgets ranged from $65,000 (Madera, CA) to $29 million (South Coast Air Quality Management District, CA).

Federal grants under section 105 contributed about one-third of State and local air agencies' budgets in 1987. On average, 50 percent of the Federal funds received by State and local agencies are budgeted for administration and planning activities (including monitoring, SIP revisions, development and maintenance of emissions inventories, air quality modeling, and development of new programs). Permitting and enforcement activities and other minor categories account for the other 50 percent.

EPA has estimated that altogether, State and local agencies would need increases in revenues totaling about $40 million per year, to fulfill all of the new requirements contained in its proposed "Post-1987" ozone and carbon monoxide policy [24].

Option 1: Increase funding for section 105 grants or make special, separate appropriations for ozone nonattainment area planning

Congress could increase appropriations for section 105 grants. Federal appropriations for State and local air programs under section 105 totaled $94.6 million, in fiscal year 1987.[5] Appropriations were reduced to $93.3 million in fiscal year 1988, and increased to $101.5 million for fiscal year 1989.[6] In 1986, Federal contributions to State agencies ranged from $180,000 (Nevada) to $5.9 million (New York). Federal contributions to local air agencies ranged from no funding for some to $1.5 million.

In addition to grants allowed under section 105, the 1977 Amendments authorized grants for planning transportation control measures. A total of $50 million was appropriated. Most of the grants, which were administered through the Department of Transportation (DoT), went to Metropolitan Planning Organizations (MPOs) responsible for developing urban transportation plans, rather than to air agencies. While it lasted (through 1982), the grants program was considered successful in introducing air quality considerations into urban transportation planning. Congress could consider new authorizations targeted specifically for grants for joint air quality/transportation planning.

Option **2:** *Develop a nationwide user-fee program (administered by EPA) or a fee requirement (administered by the States) on nonattainment area emissions.*

The Clean Air Act requires States to assess fees to cover the costs of processing, implementing and enforcing permits.[7] In 1986, 31 States assessed permit fees.[8] Some of these States covered more than half of their air agency budgets through extensive

[4] The information on State and local air agency budgets and fee programs presented in this section is from reference [16].

[5] Section 105(a)(1)(A-C) defines the maximum Federal share of funding for State and local air pollution control as 60 percent for maintaining an established program and 75 percent for planning or developing an air quality program for those recipients carrying out a SIP. A major requirement for receipt of Federal funding is that the agencies' nonfederal support for 'recurrent expenditures" cannot be reduced unless the reduction is a nonselective reduction in expenditures of all executive agencies at the same level of government.

[6] Due t. relatively flat funding levels over the past few years, in the face of increasing responsibilities and new priorities, EPA officials note a decline in Federal support for several fundamental State and local activities including: enforcement, emission inventory maintenance, ambient monitoring, and preventive activities such as new source review.

[7] Section 110(a)(2)(K) of the Clean Air Act requires States to charge owners/operators of major stationary sources for "the reasonable costs of reviewing and acting upon" applications for permits; and for 'the reasonable costs of implementing and enforcing the terms and conditions" of permits that are given out.

[8] Eleven other States had authority t. collect fees but did not. Agencies that did not collect fees cited lack of a strong signal from EPA that fee programs were required; lack of a national policy or regulation that would ensure that fee programs were not perceived as a local disincentive to industry; and concern that they would not benefit from the revenues generated (because revenues were diverted elsewhere or because other funding sources would be reduced accordingly).

user-fee programs.[9] About half of the State air agencies collecting fees retained the revenues; the other half put them into State general funds. In 60 percent of the States collecting fees, the revenues were at least reflected in the air agencies' budgets. On average, revenues raised by assessing fees equaled about 10 percent of agency budgets (irrespective of whether or not they retained the fees).[10]

Congress could shift more responsibility for funding State and local planning efforts to State and local governments, encouraging or requiring them to assess user fees to support their own activities. Agencies that do not now have permit fee programs have suggested that a Federal directive would bean important factor in their ability to obtain local authorization to assess fees. In addition to or instead of State and local assessments, Federal user fees could be instituted, with some portion turned over to State and local air agencies through EPA.

As discussed above, EPA estimates that in order to undertake the planning requirements that they have proposed, State agencies will require an additional $40 million per year. Adding requirements for state-of-the-art modeling in many areas might increase this by another 50 percent or more. Using $100 million per year as an upper bound, we can get a feel for the magnitude of the fees that would have to be imposed.

Assuming that fees are to be related to emissions, fees of about $10 per ton of VOC would be needed to raise $100 million in nonattainment areas. Identifying and imposing fees on all sources, however, would be quite difficult. Three source categories, emitting over half of nonattainment area VOC emissions, are probably the easiest to locate: large stationary sources, highway vehicles, and solvents. Roughly assigning a fee to these sources according to their contribution to emissions produces a fee schedule of about: $15 to $20 per ton of VOC emissions from stationary sources emitting more than 50 tons per year, about 0.1 to 0.15 cents per gallon of gasoline, and about 15 to 20 cents per gallon of the most commonly used solvents (such as special naphthas).

Research

Discussion

Ozone is probably the least-well understood of the six "criteria" air pollutants, those for which air quality standards have been set. This lack of understanding is one of the reasons why ozone is the criteria pollutant that we have had the least success controlling.

The next reauthorization of the Clean Air Act will include the **third** major change in the way we have attempted to control ozone. If, when the second major initiatives were taken following the 1977 Amendments, we had also launched an aggressive research program, our task might be easier today. Research begun today can help the States implement the changes made during this round of amendments and help Congress when it considers the fourth major set of changes 5 or 10 years from now.

We have identified three areas where research seems most pressing: 1) research to improve the planning process, 2) development of new control methods, and 3) research to better understand the magnitude of the risks posed by ozone. Each of these is discussed below.

Research To Improve Planning—Two areas are prime candidates for increased Federal research funds: 1) methods to allow States to improve estimates of VOC emissions; and 2) air quality models that are more accurate than the current generation of tools used by most States, and at the same time are easier to use than research-level models.

VOC Emissions Inventories—Air pollutant emissions are rarely measured, but rather are estimated using emissions models. The models used for estimating VOC emissions are far less accurate than, for example, those used to estimate either sulfur dioxide or nitrogen oxide emissions.

[9] In addition to permitting, some State or local agencies assess fees for other services such as source testing, banking and bubble applications, and motor vehicle inspections. Some agencies also assess fees on emissions.

[10] Fees collected by over 50 percent of the States were equal t. less than 3 percent of their air agency budgets. Fees amount to about 30 percent or more of the budgets of State air agencies in Kansas, Louisiana, Texas, and Ohio. Fees contribute about 30 to 80 percent of the annual budgets of local air agencies in Arizona and California.

About 10 to 20 percent of VOC emissions come from large stationary sources for which a location is identified in an inventory, for example, a petroleum refinery or a factory that manufactures chemicals. These sources can be surveyed individually and emissions can be estimated reasonably well based on production levels.

About 40 percent of VOC emissions come from highway vehicles. Emissions are estimated using a model called Mobile-4. Mobile-3, the previous version of the model, was based on data collected from about 11,000 vehicles manufactured before 1982 (with about half of these manufactured before 1976). Though Mobile-3 was widely criticized as not able to adequately simulate emissions under road conditions, data from fewer than 500 vehicles were used to update the model [25]. Given the changes in vehicle design that have occurred over the last several years-and the importance of highway vehicle emissions-additional funds to EPA to test newer vehicles and improve the performance of Mobile-4 would be well spent.

Another 25 to 30 percent of VOC emissions come from a diverse range of solvent uses, including drycleaning, consumer products, and coatings for everything from furniture to cars to houses. While nationwide emissions can be estimated from published statistics of total solvent produced, emissions in any given nonattainment area can only be crudely guessed. The method currently being used was developed in 1975 and has been modified little since that time. Improvements are sorely needed.

The magnitude, distribution, and role of "biogenie " emissions-natural hydrocarbon emissions primarily from forests—are also poorly understood and characterized. Nationwide, summertime VOC emissions from natural sources are estimated to be greater than man-made emissions. Natural-source VOCs are emitted primarily in forested areas, that is, outside of nonattainment areas where man-made emissions of VOCs generally predominate. Nevertheless, in some parts of the country (especially the Southeast), VOC emissions from vegetation may contribute substantially to ozone nonattainment problems. Improved understanding of biogenic emissions will help such areas determine how best to control ozone—in particular, whether emphasis needs to be placed on reducing NO_x emissions if a significant fraction of VOCs are not subject to control.

Air Quality Models—A wide disparity exists between the accuracy of the best available air quality models and those commonly used by the States to prepare their SIPS. The best available tools are expensive to use, require extensive data collection, and require highly trained personnel to be used effectively. Thus, state-of-the-art models are beyond the capabilities of many of the State air pollution control agencies that might make use of them.

Though the **best** models may be beyond the States' reach, **better** models are not. More EPA attention to the operational aspects of modeling—developing tools for the average rather than the expert modeller—could improve the States' abilities to understand the effectiveness of alternative emission controls.

New ***Control Methods-As*** discussed previously, OTA estimates that controls sufficient to achieve about two-thirds of the reductions needed to attain the standard will cost about $10 billion per year. We cannot estimate the costs of the remaining third because we do not know how it can be achieved. Yet EPA's total research budget for new and cheaper VOC control measures totals about $1.5 million per year-much less than one-tenth of a percent of the projected costs of control.

Once currently available controls are in place, the remaining emissions will come primarily from small (less than 50 tons per year) stationary sources and highway vehicles. High-priority research and development areas include methods to trap or destroy VOCs from small sources emitting VOCs in low concentrations, non-ozone producing solvent substitutes, and cleaner vehicle fuels, such as methanol and compressed natural gas.

Better Understanding of the Problem—The current regulatory program is focused mainly on one of ozone's effects, acute health effects resulting from exposure to short-term peaks. Other effects are also of concern, including possible chronic health effects from long-term exposure to ozone and effects on crops and forests. Additional research is needed in each of these areas.

Chronic Health Effects—Although the short-term effects of ozone are important, many health professionals appear to be more concerned that repeated exposure to ozone over many years may result in permanent impairment of the lung. Unfortunately, the limited research that has been conducted to date has been unable to either confirm or dismiss this concern.

Most of EPA's health effects research focuses on ozone exposures of one to several hours. Information about the chronic effects of exposure to ozone over longer time periods—days to years-must come from a combination of animal studies and carefully planned epidemiologic studies.

Welfare Effects—For decades we have known that ozone can harm plants. Just how much damage is occurring in specific agricultural and forested regions, however, is not well understood. In chapter 4 we estimate that if seasonal, daytime average ozone concentrations could be lowered by 25 percent of the amount by which they exceed natural background, about $0.5 billion to $1 billion per year of agricultural benefits would be gained. We are not yet able to estimate the amount of forest damage that might be avoided.

While a fair amount of research on the effects of ozone on crops and forests is currently underway, major information gaps remain. Much has already been learned about crop damage through the EPA sponsored National Crop Loss Assessment Network (NCLAN), but many scientists feel that the research effort was ended prematurely. We are still uncertain whether productivity declines are due primarily to intermittent peak concentrations or the accumulated ozone dose over a growing season. Forest effects are being studied under the National Acid Precipitation Assessment Program (NAPAP) and under the new 10-year research program established at the end of the 100th Congress by the Forest Ecosystems and Atmospheric Pollution Research Act.

A goalof both research efforts should be to enable EPA to set a secondary 'welfare" standard based on crop and forest effects. The current secondary standard is identical to the health-based primary standard. Many feel that the form of the primary standard (i.e., a peak one-hour standard, not to be exceeded more than once per year) is inappropriate for a secondary standard to protect vegetation.

Additional monitoring of ozone and its precursors in non-urban environments is needed to better characterize the magnitude of the problem. Moreover, it is not well understood how to lower regional ozone concentrations, if Congress or EPA were to pursue this goal. The VOC reductions needed to lower peak ozone concentrations in nonattainment cities may have little effect in less populated areas; reductions in nitrogen oxide would probably be necessary to reduce ozone in most non-urban areas. Additional field studies and modeling are needed to better understand how to lower ozone concentrations in non-urban areas.

Options

Decision 1: What areas of research **deserve increased funding?**

In the discussion above, we outlined three general research areas that Congress should consider for increased funding. These include: 1) research to help the States analyze the emissions reductions needed to meet the standard, 2) research on new control methods, and 3) research to better understand other effects of ozone, including possible chronic health effects from exposure over many years and crop and forest productivity declines.

Current research expenditures in each of these areas is quite modest. EPA gives the States about $3 million per year for improved inventories, monitoring, and air quality modeling. In fiscal year 1990, EPA's Office of Air Quality Planning and Standards will itself spend about $3 million, including staff time, on developing improved ozone models and a better emissions data management system. Fiscal year 1989 expenditures were closer to $1 million [5]. The Mobile-4 model, used by the States to estimate emissions from highway vehicles, is the responsibility of the Office of Mobile Sources (OMS). In fiscal year 1989, OMS spent about $2.8 million testing cars for data needed to build the model, up from about $0.8 million in fiscal year 1987. Even at the higher level, about 900 vehicles per year can be tested (compared to a peak of about 5000 vehicles tested in 1979) [2].

About $1.5 million per year is spent by EPA's Office of Research and Development (ORD) on the "Regional Oxidants Model" (ROM), a highly sophisticated model capable of simulating multi-day ozone episodes in the Northeast. Similar efforts in the Southeast, Gulf Coast region, and the area surrounding Lake Michigan would help cities in each those regions to better understand how to solve their nonattainment problems. In addition, such efforts are needed to understand how to lower rural ozone concentrations.

OMS spent about $2.8 million in fiscal year 1989 on research on alternatively fueled vehicles, primarily methanol vehicles [2]. ORD spends about $1 million per year on research on mobile source emissions. About $0.6 million is devoted to use of alternative fuels [8]. The Air and Energy Engineering Research Laboratory of ORD spends about $0.4 million per year on research to develop new control methods for stationary sources of VOC. Most of the emphasis is on developing technology appropriate for small *stationary sources,* and on developing environmental impact guidance for manufacturers reformulating VOC-containing products [7].

ORD spends close to $7 million per year on ozone effects research. Of this, the single largest component is now research to determine the long-term health effects from ozone, about $3.6 million in fiscal year 1989. Given the importance of knowing whether there are chronic effects from exposure to ozone and if so, of what magnitude, this level of research seems extremely modest. ORD also spends about $2 million per year on forest effects research and about $1 million on continuing research on the short-term health effects of ozone [8].

Decision 2: Who pays for the research?

Traditionally the Federal Government has funded air pollution related research out of general tax revenues. While this has been generally true for most pollution related research, there have been a few exceptions. For example, in the Nuclear Waste Policy Act of 1982 (Public Law 97-425), Congress established a fee on electricity generated by civilian nuclear power reactors to be used to pay for the costs of radioactive waste disposal. While most of the fee will be used to pay for the construction and operation of a waste repository, the costs of research, development, and demonstration activities and the costs of administering the program are also covered.

Under the Superfund Amendments and Reauthorization Act of 1986 (SARA), Congress established four hazardous substances research centers, each with funding of $5 million per year from Superfund. Though Superfund is jointly funded by industry and general tax revenues, well over half of the funds come from industry.

In the discussion above on additional requirements for State planning, we presented several alternatives for raising revenues for these activities. If Congress decides to fund these activities through a fee or tax mechanism, it might also consider allocating a portion of the revenues raised to ozone-related research activities.

CONTROL REQUIREMENTS

In addition to the more generic options discussed above, Congress might want to consider requiring specific types of controls directly in the Act. We have organized our discussion of the specific options available to the Congress in the near term into three categories. Air pollution control under the Clean Air Act relies on a partnership between EPA and State and local governments. Therefore, our first two categories present: 1) federally implemented controls that apply nationwide and 2) controls to be implemented by the States in nonattainment areas. A final category includes options for managing emissions growth due to population increase and expanding economic activity in nonattainment areas

All of the control options presented in this section are available today and fall, more or less, within the traditional regulatory bounds of the Clean Air Act. The last section in this chapter presents some "New Directions for the Clean Air Act" that Congress should also consider to augment the more traditional control strategies presented here.

Federally Implemented, Nationwide Control Requirements

Discussion

Two major categories of regulations currently apply nationwide. These include emission standards for highway vehicles and a series of "new source performance standards" (NSPS) that apply to certain categories of new facilities locating in attainment areas. While NSPS regulations also apply to new facilities in nonattainment areas, they are often superseded by more stringent regulations. Note also that highway vehicle emission standards are more stringent in California, the State with the most severe nonattainment problems.

Part of the philosophy behind uniform nationwide car and truck standards is that people as well as vehicles are mobile. Obviously, it would be extremely difficult to implement and enforce a set of highway vehicle regulations that applied only to cars and trucks in nonattainment areas. For pollutants such as nitrogen oxides and carbon monoxide, the only source categories that move around are transportation related—cars, trucks, buses, trains, airplanes, and ships—and certain off-highway vehicles such as construction equipment. For VOCs, however, there are significant sources that do move around and which are not transportation related. Paints and other solvent-containing products release VOCs at the point of end-use. Since controlling the movement of certain kinds of house paints, pesticides, and similar products with high VOC content would be difficult, nationwide regulations have been proposed for these products as well.

Nationwide control requirements under current law and regulations are listed in table 8-6. Additional controls that Congress might want to specify are discussed below.

Table 8-6—VOC Sources For Which Nationwide Regulations Exist

Current law and regulations include the following controls for highway vehicles:

1. **Tailpipe exhaust standards for passenger cars:**
   a. 0.41 g/mi HC and 1.0 **g/mi NO_x.**
   b. Vehicles must be able to meet these standards for at least 5 years or 50,000 miles.
2. Tailpipe exhaust standards for light-duty trucks (less than 8,500 lb gross vehicle weight rating [GVWR]):
   a. 0.8 g/mi HC and 1.2 g/mi NO_x for trucks with loaded vehicle weights up to 3,750 lbs.
   b. 0.8 g/mi HC and 1.7 g/mi NO_x for trucks with loaded vehicle weights over 3,750 lbs. Standards must be met for 120,000 miles.
3. Tailpipe exhaust standards for heavyduty engines and vehicles (over 8,500 **lb GVWR):**
   a. 1.1 grams per brake-horsepower-hour (ghhp-hr)[a] HC and 10.6 g/hp-hr NO_x for gasoline vehicles less than 14,000 lb GVWR.
   b. 1.9 g/bhp-hr HC and 10.6 g/bhp-hr NO_x for gasoline vehicles over 14,000 lb GVWR.
   c. 1.3 g/bhp-hr HC and 10.6 g/bhp-hr NO_x for diesel vehicles.
   d. For all vehicles, NO_x standards drop to 6 g/bhp-hr in 1990 and 5 g/bhp-hr in 1991.
   Standards must be maintained for 110,000 to 290,000 miles, depending on fuel and truck weight.
4. **Limits on gasoline evaporation from highway** vehicles.

Currant law and regulations include the following controls for stationary sources:

New source performance standards (NSPS) requiring the "best available control technology" on certain new stationary sources of VOC and NO_x. (Note that the "lowest achievable emission rates" for VOC required for new sources in nonattainment **areas** are more stringent than the nationwide NSPS limits.)

1. Surface coating regulations, including NSPS for coating large appliances, metal furniture, cars and light-duty trucks, beverage cans, metal coils, magnetic tape, pressure sensitive tapes and labels, and flexible vinyl coating.
2. **Petroleum-related regulations, including** NSPS for petroleum refining, refinery wastewater, bulk gasoline terminals, storage vessels, and natural gas production.
3. Synthetic organic chemical industry (SOCMI) related regulations, including NSPS for air oxidation equipment, distillation operations, reactors, and other equipment.
4. Others including NSPS for drycleaning, graphic arts, synthetic fiber production, and rubber tire manufacture.

[a]To convert g/bhp-hr to g/mi, multiply by approximately 0.9 for gasoline vehicles and 2.0 for diesel vehicles.

SOURCE: Office of Technology Assessment, 1989.

Options

Chapter 6 presented our estimates of the emission reduction potential and costs of additional pollution controls. Those regulations that would be federally implemented are summarized below.

Option 1: Limits on gasoline volatility.

Limiting the volatility (i.e., rate of evaporation) of gasoline sold during warm weather months would substantially reduce transportation-related VOC emissions. On a warm summer day, twice as much VOC comes from gasoline evaporation than from the tailpipe of a car. Limiting the volatility of gasoline to 9 pounds per square inch (psi) Reid Vapor Pressure (RVP) from levels of between about 11.0 and 11.5 psi would lower VOC emissions about 3,700 tons per *day* on hot summer days in nonattainment cities in 1994. (This is equivalent to an *annual* reduction of about 1.3 million tons per year, or about 12 percent). An additional 5,200 tons per day would be eliminated in attainment areas (equivalent to annual reductions of about 1.9 million tons).

EPA estimates that the costs for lowering gasoline volatility during the 5 summer months would be about $0.2 billion per year nationwide; the American Petroleum Institute estimates that the costs would be closer to $1 billion per year nationwide. The resulting cost-effectiveness ranges between about ***$120*** and $800 per ton of VOC during the 5 summer month period.

Note that the reduction estimates and costs above assume as a baseline gasoline volatility in the range of 11.0 to 11.5 psi, which prevailed throughout most of the United States during the summer months between 1985 and 1988. They do not use as a baseline the recently promulgated EPA regulations requiring gasoline volatility of 10.5 psi beginning during the summer of 1989 or several northeastern state regulations requiring 9.0 psi, also beginning in 1989.

Option 2: More stringent exhaust standards for cars and trucks.

Table 8-7 displays OTA's estimates of the most stringent car and truck emission standards that are feasible with currently identifiable technology.[11] About 4 years lead time might be needed for manufacturers to design, test, and certify vehicles meeting these lower standards. We feel that the emission rates listed can be met as "certification standards, " that is, emission rates after 50,000 miles on a test track. The emission rates might also be met by well-maintained vehicles after 50,000 miles in customer service. However, vehicle emissions could easily be higher after 50,000 miles in normal customer service.

As these are estimates of emission rates from vehicles not yet designed, they should be viewed with some caution. On reviewing the contractor work on which the table is based, the auto and truck manufacturers felt that the OTA contractor's estimates of feasible emission standards were too optimistic. Both EPA and the California Air Resources Board, however, felt that the standards were too conservative. They felt that the numerical standards could be met not only during certification but after 50,000 miles in customer service. Though they could not identify the particular technology mix that would assure meeting the standards in customer service, they believed that the manufacturers have the technical capability to develop such a system if forced by law.

Assuming these new highway vehicle standards go into effect in 1994, costs would total about $2.9 billion dollars per year nationwide and lower VOC emissions by 330,000 tons per year and NO_x, emissions by 1.3 million tons per year by 2004 (when most older vehicles will have been replaced). About 45 percent of the emission reductions would be in nonattainment areas.

Table 8-7-Options for New Car and Light-Duty Truck Exhaust Standards

Alternative 1: Most stringent standard[a] with currently identifiable technology	
For passenger cars:	
0.25 g/mi NMHC	**0.4** g/mi NO_x
For light-duty gasoline trucks weighing less than 3,750 pounds:	
0.25 g/mi NMHC	0.4 g/mi NO_x
For light-duty gasoline trucks weighing between 3,750 and 6,000 pounds:	
0.32 g/mi NMHC	0.7 g/mi NO_x
For light-duty gasoline trucks weighing more than 6,000 pounds:	
0.41 g/mi NMHC	1.5 g/mi NO_x
Alternative 2: More stringent than current stamdards, less stringent than those listed above	
For passenger cars:	
0.25 g/mi NMHC	0.7 g/mi No_x
For light-duty gasoline trucks weighing less than 3,750 pounds:	
0.41 g/mi NMHC	0.7 g/mi NO_x
For light-duty gasoline trucks weighing between 3,750 and 6,000 pounds:	
0.50 g/mi NMHC	1.0 g/mi NO_x
For light-duty gasoline trucks weighing more than 6,000 pounds:	
0.50 g/mi NMHC	1.0 g/mi NO_x

[a]All standards are based on a 50,000-mile certification requirement. Hydrocarbon standards are for non-methane hydrocarbons (NMHC), not total hydrocarbons.

SOURCE: Office of Technology Assessment, 1969.

Table 8-7 also presents a second possible set of standards that are more stringent than those in place today, but not quite as difficult or expensive to achieve than those discussed above [11]. These new standards would cost about $1.3 billion per year by 2004 and achieve about 65 percent of the VOC reductions and 55 percent of the NO_x reductions of the more stringent standards discussed above.

Option 3: "Onboard" technology for cars and trucks to control refueling emissions.

Gasoline vapors that escape from vehicle fuel tanks during refilling can be controlled by two different methods. The first, 'stage-II" vapor recovery devices on gas pumps, was discussed above as an option that can be limited to nonattainment areas only. Control devices can also be installed ''onboard" cars and trucks that can lower refueling emissions by about 90 percent. VOC emissions

[11] These options are based on a report to OTA by Sierra Research [11], a consulting firm that provides services to a variety of auto industry, oil industry, and regulatory agency clients.

could be lowered by about 530,000 tons per year nationwide, at a cost of about $600 million per year by 2004. This nationwide cost is based on a per vehicle cost of $25, the upper bound of EPA's estimates. The Motor Vehicle Manufacturers' Association estimates that the cost would be $80 per vehicle.

In August 1987, EPA published a notice of proposed rulemaking in requiring all gasoline-fueled cars and trucks manufactured after 1990 to have onboard technology to control refueling emissions. A final rule has not yet been issued.

Option 4: Federal solvent regulations.

STAPPA/ALAPCO, the associations of State and local air regulatory agencies, has recommended that *Congress* require EPA to develop and implement a set of Federal regulations for the following solvent categories: 1) commercial solvents, 2) consumer solvents, 3) architectural coatings, 4) pesticide application, 5) traffic-marking coatings, and 6) metal-parts coatings for military applications and aerospace-industry applications [15].

STAPPA/ALAPCO's reason for advocating nationwide requirements, rather than requirements for nonattainment areas only, is that such products are "manufactured and marketed regionally and nationally (rather than by individual States)." STAPPA/ALAPCO states only that they believe that control measures are technologically feasible, but does not state the reductions that might be achieved or the cost.

The emissions reductions from, and costs of, regulations on the solvent content of architectural coatings are discussed in chapter 6. Emissions could be lowered by about 0.5 percent per year at a nationwide cost of about $0.13 billion. Regulations on other categories of solvent use are discussed in a later section on "New Directions for the Clean Air Act."

Control Requirements To Be Implemented by States in Nonattainment Areas

Discussion

The Clean Air Act divides the responsibility for air pollution control programs between EPA and State and local governments. EPA is responsible for setting emission standards for new motor vehicles. The States are responsible for implementing inspection and maintenance programs in nonattainment areas to ensure that motor vehicles continue to operate properly.

The States are responsible for applying emission controls to existing stationary sources. While EPA issues regulations for new stationary sources that apply nationwide, States are required to apply more stringent requirements in nonattainment areas, that is, the 'lowest achievable emission rates" from new stationary sources.

In 1985, about half of all VOC emissions came from stationary sources, and therefore were the responsibility of the State to control. In the absence of further regulations, within a decade the percentage could rise to about 60 percent. Thus the importance of State-implemented, as opposed to federally implemented, controls will increase.

We will first review the controls that States are already required to implement in nonattainment areas under the Clean Air Act, and then present additional controls that Congress could add to the Act.

The 1977 Amendments created two categories of nonattainment areas. The following State-implemented controls were required under regulations issued by EPA:

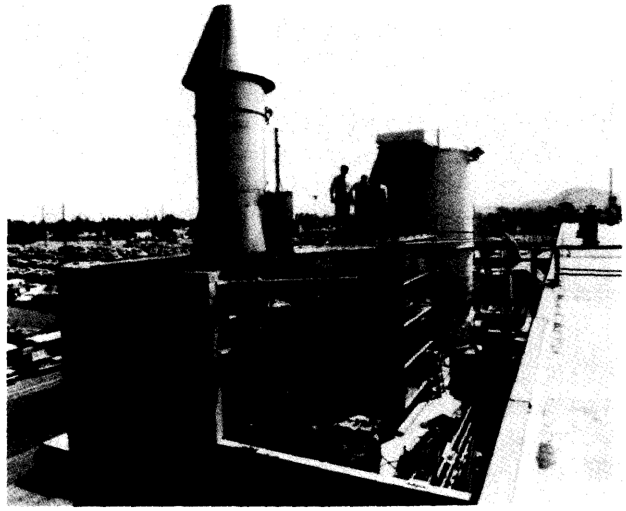
- In areas that could demonstrate attainment by December 1982:
  - —"Reasonably available control technology" (RACT) for all stationary sources of VOC emitting more than 100 tons per year, for which EPA issued 'control technique guidelines" (CTGs) prior to 1979. (Source categories are listed in table 8-8.)
- In areas that received extensions of the attainment deadline to December 1987 ("extension" areas):
  - —RACT for all stationary sources of VOC for which CTGs have been issued. (Source categories are listed in table 8-8.)
  - —RACT for all stationary sources of VOC emitting greater than 100 tons per year for which CTGs have not been issued.
  - —Inspection and maintenance (1/M) program for highway vehicles.

Table 8-8—VOC Sources For Which EPA Hss Issued Control Technique Guidelines

EPA has issued "control technique guidelines" (CTGs), which presumptively determine RACT, for the following source categories:

1. Prior to 1979:
   - a. Surface coating regulations, including CTGs for coating cans, coils, paper, fabrics, autos and light-duty trucks, metal furniture, magnet wire, large appliances, flatwood paneling, and miscellaneous metal parts.
   - b. Other solvent-related regulations, including CTGs for graphic arts, metal decreasing, and drycleaners using perchloroethylene.
   - c. Petroleum-related regulations, including CTGs for bulk gasoline plants and terminals, liquids in fixed- and floating-roof tanks, miscellaneous sources in petroleum refineries, gasoline tank trucks, and delivery of gasoline to service stations.
   - d. Several additional regulations, including rubber tire manufacture, pharmaceutical manufacture, and cutback asphalt.
2. 1979 and later:
   - a. Large petroleum drycleaners.
   - b. Synthetic organic chemical industry (SOCMI) related regulations, including CTGs for high-density plastic resins, air oxidation processes, volatile organic storage tanks, and leaks.
   - c. Leaks from natural gas and gas processing plants.

SOURCE: Office of Technology Assessment, 1989.



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—"Lowest achievable emission rate" (LAER) of VOC for new stationary sources emitting more than 100 tons per year or modified stationary sources emitting more than 40 tons per year.

Options

Chapter 6 presented our estimates of the emissions reductions potential and costs of currently available currently methods. Those measures from chapter 6 that can be implemented by States, as well as a few additional ones, are discussed below:

Option 1: Lowered source-size cutoff for requiring "reasonably available control technology" (RACT).

EPA currently requires RACT-level controls for stationary sources that emit, or have the potential to emit, over 100 tons per year of VOC. (The Act currently requires all reasonably available control measures, but is silent on the source size cut-off.) Congress could lower this cutoff to, for example, 50-or 25-ton-per-year sources in all nonattainment areas or require progressively lower cutoffs depending on design value. For example, Congress might maintain the current 100-ton-per-year cutoff in areas with design values close to the standard (e.g., 0.13 ppm or lower), require a 50-ton-per-year cutoff for most nonattainment areas, and require a 25-ton-per-year cutoff for the worst areas. Estimating the reductions from such a change is quite difficult because the nationwide emissions inventory maintained by EPA does not include detailed information on sources that emit less than 50 tons per year of VOC. In chapter 6, we estimate that emissions in nonattainment cities could be lowered by about 4 percent by requiring RACT-level controls for all sources that emit more than 25 tons per year.

Option 2: Require EPA to define RACT for additional source categories.

EPA has issued "control technique guidelines" (CTGs), which presumptively determine RACT for about 30 source categories. State and local agencies are able to use these documents as a basis for regulations in their nonattainment areas. EPA has not issued any new CTGs for several years.

State regulatory agencies have been particularly strong advocates of requiring EPA to issue additional CTGs, both in OTA sponsored workshops and in a position paper by STAPPA/ALAPCO [15]. State air program administrators have stated that it is difficult for many agencies to impose controls on source categories for which EPA has not issued CTGs, even though the Act clearly states that all stationary sources in nonattainment areas must apply RACT-level controls.

STAPPA/ALAPCO recommends that EPA issue CTGs for at least the following source categories: hazardous waste treatment, storage, and disposal facilities; stage II vapor recovery; wood furniture coating; autobody refinishing; coke oven byproduct plants; bakeries; sewage treatment plants; synthetic organic chemical industry (SOCMI) batch process; SOCMI distillation; web offset lithography; metal rolling; plastic parts coating; and marine vessels.

We estimate that RACT-level controls on the frost seven source categories listed above could lower nonattainment area VOC emissions by about 8 percent in 1994. Note, however, that most of the reductions-about 68 percent—come from one source category, hazardous waste treatment, storage, and disposal facilities. Costs to implement these controls would total about $1.3 billion per year in 1994.

Option 3: More stringent requirements for motor vehicle inspection and maintenance programs.

Improper maintenance, tampering with emissions control systems, and component defects all result in vehicle emissions in customer service at rates higher than the standard. To correct these deficiencies, Congress, in the 1977 Clean Air Act Amendments, required motor vehicle inspection and maintenance (I/M) programs in nonattainment areas that could not meet the standard by 1982. Thirty States, plus the District of Columbia, have I/M programs in place. However, the effectiveness of the program varies considerably from State to State. A well-implemented 1/M program, such as California's, can lower VOC emissions by about 12 percent and NO_x emissions by about 4 percent [11]. Poorly implemented programs may achieve very little emissions reductions.

Obviously, for an I/M program to succeed, improperly functioning vehicles must be both identified and then repaired. Some programs employ test methods that allow many poorly functioning vehicles to pass; a few programs do not test tailpipe emissions at all but only perform a visual inspection. Other programs may identify poorly functioning vehicles but only require that repairs costing $50 or less be made.

In a study of ways to improve California's existing I/M program, Sierra Research, Inc. identified a series of measures that could increase VOC reductions from I/M from 12 percent of motor vehicle emissions (current effectiveness) to about 30 percent [10]. Such an ''enhanced" I/M program would include: 1) more stringent emission standards, 2) centralized inspections or private garage inspections using computer-controlled analyzers with data recording, 3) visual and functional inspection of the emission control system, 4) repair cost ceilings high enough to ensure that most vehicles that fail the inspection will be completely repaired (about $500), and 5) adequate inspection fees to cover the cost of doing the inspection properly [11].

Such a program would cost about $50 per vehicle per year-$20 per year for the inspection fee and program administration and repair costs averaging $70 to $100 for an estimated 20 to 35 percent of the vehicles that might fail. The program would lower total VOC emissions by about 1 percent and NO_x emissions by about 3 percent by 1994. Total costs of an enhanced I/M program in all nonattainment areas would be about $1.5 billion to $3.5 billion per year.

Option 4: Required use of alternative fuels by centrally owned fleets.

In chapter 7, we discuss the emissions reductions that could be achieved by requiring centrally owned fleets of vehicles to use either methanol or compressed natural gas instead of gasoline. Methanol vehicles used within the next 10 years would probably be operated on blends of methanol and gasoline. CNG vehicles would probably be "dual-fueled, " operating part time on CNG and part time on gasoline, Although current projections of VOC reductions that could be realized are uncertain, our best estimate is that total (exhaust and evaporative) emission rates would effectively be about 30 percent lower for these alternatively fueled vehicles than for gasoline vehicles meeting current standards and operated on low volatility gasoline (Reid Vapor Pressure [RVP] of 9.0 pounds per square inch [psi]) **[1,20].**

Based on experience in the United States and elsewhere, it appears feasible to modify or design vehicles to operate on either CNG or methanol, with performance that is generally comparable to that of gasoline vehicles. The limited distance that can be driven on CNG without refueling is currently a disadvantage, compared to gasoline or methanol. Safety concerns related to the toxicity of methanol still need to be addressed before methanol/gasoline blends are widely utilized. Safety, emissions, and fuel economy standards are needed for CNG and methanol vehicles, and fuel storage and handling standards are needed for methanol.

Our analysis for the period through 2004 considered use of alternative fuels by vehicles that are owned and operated as fleets of 10 vehicles or more (e.g., by businesses or local governments) in areas with peak ozone concentrations of 0.18 ppm or higher. We limit the requirement to the worst areas for two reasons: 1) at least over the next decade, the costs of switching to either methanol or CNG would be quite high; and 2) if methanol is the fuel of choice, demand for the fuel from the 17 areas considered would about equal upper bound estimates of current excess production capacity worldwide. Additional demand would increase the cost of the option further, and could not be met in the near term.

There are several advantages to requiring vehicles operated in fleets to use alternative fuels, rather than applying the requirements to vehicles in general service. Especially for vehicles that are refueled at a central location, the network of stations needed would be limited. And, although only about 6 percent of vehicles are in centrally owned fleets, they account for over 12 percent of the total mileage traveled each year, improving the cost effectiveness of conversion. Finally, fleet vehicles are currently replaced every 3 years, on average, compared to a 10-year turnover rate for vehicles in general use, suggesting that benefits would accrue more rapidly with fleets.

We estimate that fleets in the areas we considered currently purchase about 500,000 vehicles per year. Subsidies might be needed to dissuade businesses from simply disbanding their fleets to avoid extra costs. In addition to requiring that fleets purchase alternative-fueled vehicles, manufacturers may have to be provided incentives or required to produce them.

Our best estimate is that use of methanol blends would lower in emissions in the areas in which it is required by about 0.5 to 0.7 percent per year, after full conversion of fleets of 10 or more vehicles. Use of CNG in fleets 75 percent of the time would lower emissions by about 1.3 percent.

Assuming that methanol blended with 15 percent gasoline is used, these reductions would cost from $8,700 to $51,000 per ton of VOCs eliminated, totaling $120 million to $710 million per year in areas with design values of 0.18 ppm or higher. For dual-fueled CNG vehicles using CNG 75 percent of the time and gasoline the remaining 25 percent, the cost would be from $400 to $22,000 per ton. In both cases, the costs are extremely sensitive to fuel prices.

Use of alternative fuels in vehicles in general service is discussed under "Long-Term Control Strategies," below.

Option 5: Transportation control measures.

Under the general heading of "transportation control measures" (TCMs), people refer to a set of interrelated approaches that either reduce highway vehicle use or lower emissions per trip by increasing average vehicle speed. Examples of the former include improved public transit, highway lanes for the exclusive use of buses and carpools, bicycle lanes, parking management, and road-use restrictions or tolls. Measures such as traffic flow improvements and modified schedules for work do not lower highway vehicle use but can reduce emissions by reducing congestion, thus cutting the numbers of hours vehicles are on the road. Transportation control measures were included in most States' 1979 and 1982 SIP revisions, typically with only modest emissions reductions expected from them.

Since transportation control measures have to be tailored to local conditions, and since different programs will be most effective in different areas, States need to be allowed some flexibility in applying them. Tying the implications of failing to meet interim emissions reduction requirements to growth restrictions or limitations on Federal highway funds could encourage local officials involved in transportation and land-use planning to participate in the development and implementation of TCMs.

The benefits of some programs, such as requiring companies to give their employees incentives for ride sharing, designating high occupancy vehicle lanes, and synchronizing traffic signals, can be realized fairly quickly. Experience in the Los Angeles area during the 1984 Olympics illustrated that some TCMs, for example, modified work and delivery schedules and increased transit service and usage, can yield substantial benefits with little lead time [14]. On the other hand, although the TCMs contained in the 1988 Air Quality Maintenance Plan for the Los Angeles area are expected to reduce highway vehicle VOC emissions by 30 percent in 2010, only a 3-percent reduction is expected from them in 1994 [13]. Because the potential for reducing emissions appears greatest if TCMs are viewed as long-term measures, further discussion of this option is presented in the section discussing "New Directions for the Clean Air Act."

Option 6: Tax on gasoline.

The cost of using one's car influences the number of miles per year that people travel. As the price of gasoline goes up, vehicle miles traveled go down, at least in the short term. A gasoline tax, therefore, is another available option for lowering emissions from highway vehicles in nonattainment areas. For the first few years of a tax set at about $0.25 per gallon, automobile travel would be expected to drop about 8 percent. If a tax were set at about $0.50 per gallon, automobile travel would be expected to drop about 15 percent during the first few years. Over the longer term, per capita travel might remain at the lower level, might drop even further if economical and convenient mass transit were made available, or most likely, per capita travel would begin to rise again as people compensated for the gasoline price hike by buying more fuel efficient cars.

If the only benefits one counts from a gasoline tax is the reduction in VOC emissions, the cost-effectiveness of a gasoline tax is quite high. We estimate that the emissions reductions from a gasoline tax would cost about $35,000 to $75,000 per ton of VOC over the first few years, possibly $100,000 to $200,000 per ton over the long term. Of course, there are additional benefits, including lower emissions of carbon monoxide, nitrogen oxides, and carbon dioxide; reduced highway congestion; and less reliance on imported oil.

Managing Growth

Discussion

Underestimating emissions growth is one of the most often cited reasons for the failure to meet the 1987 attainment deadline of the current Clean Air Act Amendments. In particular, few areas accurately forecast the increase in automobile use that occurred, offsetting much of the gains made by the lower motor vehicle emission standards required under the Act. This illustrates a problem with the present Clean Air Act. Most regulations control emission *rates (e.g.,* grams of pollutant per mile traveled) rather than limiting the total amount of pollutant emitted throughout a nonattainment area. Thus, emission trends are the result of a race between declining emission rates and increasing use of goods and services.

In chapter 6, we presented our estimates of VOC emissions trends over the next 15 years, assuming no change in existing regulations. The projections serve as a baseline against which to gauge the effectiveness of future regulations, including a way to judge how well current regulations will manage future emissions growth. We estimate that total VOC emissions will continue to drop a few percent through about 1995 but then return to 1985 levels by 2004.

We project that the current motor vehicle control program will continue to lower highway vehicle emissions to about 30 percent below 1985 levels by 1999 and then emissions will begin to rise again. Without tighter standards or limits on vehicle use, gains from replacement of older vehicles by newer, cleaner ones will out pace emissions increases due to increased vehicle use by the mid to late 1990s in most nonattainment areas.

In contrast, stationary source emissions in nonattainment areas are forecast to increase steadily, showing a 10-percent increase by 1994 and about a 20-percent increase by 2004, over 1985 levels.

Growth in emissions from small stationary sources (i.e., those emitting less than 50 tons of VOC per year) is the primary contributor to this increase.

Under the current Act, in nonattainment areas, new stationary sources emitting more than 100 tons per year or modified stationary sources emitting more than 40 tons per year must install controls that achieve the "lowest achievable emission rate" (LAER) for VOC. Moreover, emissions increases must be offset by emission reductions elsewhere in the nonattainment area. However, about 14 percent of stationary source VOC emissions originate from sources larger than 100 tons per year. Somewhere in the range of 55 to 80 percent of stationary source emissions originate from sources smaller than 25 tons per year. Thus, while the stationary source requirements of the current Act limit growth to some degree, a large majority of emissions are not affected by these regulations.

Options

Option 1: Lower the cutoff for new source control requirements.

As discussed above, current regulations require that in nonattainment areas, new stationary sources emitting more than 100 tons per year, or modified stationary sources emitting more than 40 tons per year, install controls that achieve the "lowest achievable emission rate" (LAER) for VOC. Lowering this threshold, for example to 25 or 50 tons per year for new sources and 10 or 20 tons per year for modified sources, would further control future emissions growth. Requirements to offset emissions increases should also apply to these smaller sources.

Option 2: Eliminate "netting out" of new source control requirements.

Current regulations allow sources to avoid the new source control requirements described above by lowering emissions at one place in a facility to keep the total facility-wide increase below 100 tons per year. For example, anew source that emits 120 tons per year in a larger facility does not have to install controls that achieve LAER if reductions of at least 20 tons per year are made elsewhere in the facility, keeping net emissions increases below 100 tons per year. Concern over this provision stems from the belief that in many cases, the reductions that are made elsewhere in the facility would have happened regardless of whether the new source was installed or not. Allowing netting, therefore, eliminates the reductions that might be achieved through normal operation improvements or retirement. We cannot estimate how often this loophole is exploited.

Eliminating netting would hold down emissions growth somewhat, but it is difficult to estimate the magnitude of reductions or costs from such a change. EPA has estimated that reductions of about 400,000 tons per year might be possible through tighter new source control requirements, including adoption of both this option and option 1 above [21]. A "back-of-the-envelope" calculation using our estimates of the distribution of source sizes and expected growth rates yields a considerably lower reduction estimate, about 100,000 to 150,000 tons per year.

Option 3: Areawide emission ceilings.

Most regulations under the Clean Air Act limit emission *rates*, not areawide emissions. increased motor vehicle use or growth in the number of, and therefore emissions from, small sources will eliminate some of the gains made from stringent emission regulations. In the section above on "Interim Requirements" we discuss the advantages and disadvantages of specifying areawide emission reduction schedules in addition to setting a deadline for attaining the standard. Such interim requirements might apply to total areawide emissions or apply only to a subset of sources that are particularly difficult to control. For example, areas might be limited to a specified rate of increase in vehicle miles traveled or might have limits on total solvent use within the area.

Though implementation of areawide emission limits would require an extensive and detailed inventory, the advantage is that nonattainment areas would be made accountable for all emissions increases on a continuing basis, rather than only by the attainment deadline, as is currently the case.

NEW DIRECTIONS FOR THE CLEAN AIR ACT

Controlling local VOC emissions will not be sufficient in many nonattainment areas to comply with the ozone standard. Part of the problem, of course, is that currently available control measures are inadequate to achieve the reductions that would be necessary. In some areas, though, it may be especially difficult to attain the standard if local NO_x emissions and/or VOC and NO_x emissions in upwind areas are not reduced concurrently with local VOC emissions.

The starting point for this section is the assumption that the primary strategy for reducing urban ozone that is followed by EPA and most States will continue to be controlling VOC emissions in nonattainment areas. Focusing on the objective of reducing urban ozone, this section presents options for additional controls, including: 1) controlling NO, emissions in nonattainment areas, 2) controls on NO_x and VOCs in areas upwind of nonattainment areas, and 3) several long-term strategies to attain and maintain compliance with the standard.

In a fourth section, we present options for reducing ozone in rural areas to prevent damage to crops and trees.

Controls on Emissions of Nitrogen Oxides in Nonattainment Areas

Discussion

Ozone is produced via chemical reactions involving both VOCs and NO,. In the past, EPA has encouraged exclusive reliance on control of VOC emissions to achieve compliance with the ambient air quality standard for ozone.

The effect of controlling NO_x emissions in nonattainment areas will be mixed. If NO_x emissions are controlled, peak ozone concentrations will be lower in some areas but higher in others, compared to levels that would have been obtained with VOC controls alone. Our ability to make reliable predictions about whether or not NO_x controls will be helpful is limited, at present, because the modeling and data gathering needed to do so have not been done for most cities. Even in the most well-studied area, Los Angeles, the issue is not clear cut: modeling studies suggest that the effects of NO_x control differ across locations within the LA basin, and that they may change from day to day depending on meteorological conditions.

EPA has used its "Regional Oxidant Model" (ROM) to investigate the effect of reducing VOC and NO_x emissions in the Northeast. Totaled overall of the urban areas in the modeling region, reducing NO_x emissions by 27 percent and VOC emissions by 42 percent below 1980 levels is predicted to yield an improvement compared to controlling VOC emissions alone. However, underlying the overall improvement are impacts of NO_x control that vary from city to city. For example, in the Pittsburgh area, NO_x controls are predicted to *increase* potential population exposures to ozone concentrations above the standard, whereas in Hartford, they are predicted to be especially helpful in *lowering* them. These results should be considered preliminary, because ROM's development and evaluation are not complete. Moreover, changes in base emissions levels since 1980, and consideration of other control strategies or meteorological episodes might alter these conclusions.

Based on measurements of the balance in urban air between VOCs and NO_x, a very preliminary judgment can be drawn that in general, Southern cities are more likely to benefit from NO_x controls than cities in the Midwest or Northeast. However, modeling calculations similar to those done for the Northeast would need to be done for the South before much confidence could be assigned to such a generalization.

As with VOC controls, two broad categories of NO_x controls are possible: 1) federally implemented controls that apply nationwide and 2) controls implemented by the States in individual nonattainment areas. Given the characteristics of the problem, Congress may choose to treat the two categories differently. Congress may wish to allow the States or EPA to decide where to require those NO_x control measures that can be implemented in some nonattainment areas without being imposed in others. For those controls that are difficult to implement area by area-in particular more stringent motor vehicle standards-Congress must judge whether the reductions will, overall, do more good or harm.

Complicating the decision about whether to mandate NO_x controls is our understanding that NO_x emissions affect more than just nonattainment area ozone concentrations. NO_x emissions contribute to acid deposition and are a major determinant of elevated ozone concentrations in agricultural and forested regions. Thus, Congress' decision about how to treat NO_x emissions depends on the goals it is trying to achieve: 1) lowering peak ozone concentrations in urban areas, 2) lowering exposure of crops and forests to ozone over the growing season, and/or 3) reducing acid deposition levels. NO, reductions can have either a beneficial or detrimental effect on peak ozone concentrations in nonattainment areas, depending on city-specific conditions. NO, reductions will most likely lower both acid deposition and regional ozone concentrations.

In 1985, total NO_x emissions in nonattainrnent areas were about 7.1 million tons. On average, mobile and stationary sources contribute about equally to NO_x emissions in nonattainment areas, although the split varies from city-to-city. Without new controls, NO_x emissions in nonattainment areas in 2004 are projected to be 8.7 million tons (a 23-percent increase), with about 30 percent of the total from highway vehicles and about 45 percent from large stationary sources. Almost no growth is anticipated in highway vehicle emissions between now and 2004, as increased vehicle miles are expected to be offset by lower NO_x emissions per vehicle.[12]

Options

Option 1: Congressionally mandated NO_x controls.

By imposing a package of more stringent light-duty vehicle exhaust standards,[13] nonattainment area NO_x emissions could be reduced by about 0.5 million tons (about 7 percent of 1985 levels) in 2004. Nationwide, a total of 1.3 million tons of NO_x would be eliminated, at a cost of $2.9 billion (combined cost for both more stringent VOC and NO_x controls). New standards have already been adopted in California, to take effect in 1990, so no reductions there are attributed to this option (i.e., 1.3 million tons are reduced outside of California).

Since 1977, California has had more stringent NO_x standards for motor vehicles than the rest of the United States. As an alternative to legislating a more stringent standard nationwide, Congress could choose to continue having two sets of motor vehicle NO_x standards, but extend the applicability of the stricter standard beyond California. For example, cars sold in States with ozone nonattainment areas might be subject to more stringent standards than cars sold in other States. About 10 States do not have any nonattainment areas.

Option 2: Presumptive NO_x controls, with EPA authority to exempt areas under specified situations.

In chapter 7, we estimate emissions reductions from applying "reasonably available" control technology (RACT) for nitrogen oxides to five stationary source categories: electric utility boilers, industrial boilers, stationary engines, gas turbines and process heaters. Imposing RACT-level controls on electric utility boilers that are located in nonattainment areas and emit more than 100 tons per year of NO_x would result in emissions reductions in 2004 of about 0.9 million tons (about 13 percent of the 1985 nonattainment area total), at a cost of $360 million per year. RACT-level controls for the other four source categories would result in reductions of 0.3 million tons (about 5 percent) in the year 2004, and cost about $310 million per year. Control technology also exists that would reduce NO_x emissions from electric utility boilers by approximately twice as much as RACT. Application of this technology in all nonattainment areas would cost over $8 billion.

As discussed in the section above on nonattainment area-specific controls, an "enhanced" inspection and maintenance (I/M) program for highway vehicles could lower total VOC emissions in nonattainment areas by about 2 percent, and NO_x emissions by about 3 percent. Most of the currently operating I/M programs focus on VOCs, carbon monoxide, or both. If NO_x requirements were added in all nonattainment areas, reductions of about 200,000 tons could be obtained in 2004 from enhanced I/M programs. Attributing one-sixth of the

[12] Current exhaust standards for NO_x were listed in the earlier section on federally implemented controls.

[13] The new emission standards used in our analysis are as follows:
(in grams of pollutant emitted per mile travelled [g/mile] for non-methane hydrocarbons [NMHC] and NO_x)
Passenger cars- NMHC: 0.25 g/mile; NO_x: 0.4 g/mile
Light-duty gasoline trucks (by truck weight)—
(less than 3,750 lbs) NMHC: 0.34 g/mile; NO_x: 0.46 g/mile
(3,751 to 6,000 lbs) NMHC: 0.43 g/mile; NO_x: 0.80 g/mile
(6,000 to 8,500 lbs) NMHC: 0.55 g/mile; NO_x: 1.15 g/mile

total cost of enhanced I/M programs to NO_x, these reductions would cost about $500 million. We assume that enhanced I/M programs would not be required for the sake of NO_x reductions alone, but to reduce VOC and in some cases CO emissions as well.

Because both stationary source control measures and highway vehicle I/M programs are implemented at the State or local level, Congress can be selective about where to require them. For example, Congress might limit imposition of these NO_x control requirements to nonattainment areas with design values above a specified cutoff (e.g., 0.16 ppm and higher). Congress could also allow the Administrator to exempt areas where he or she determines that stationary source NO_x controls would be ineffective or counterproductive.

Option 3: Requirements for evaluating NO_x controls.

Rather than presumptively requiring NO_x controls, Congress could require some States to assess their likely impact on air quality, and require them if they appear beneficial.[14] Areas in which available VOC controls were not sufficient to enable them to meet the standard by a specified deadline could be targeted for this requirement. Based on our analysis, this would include most areas with design values of 0.16 ppm or higher. NO_x controls could be mandated in these areas if analysis indicates that, for example, *peak* ozone concentrations or some measure of *exposure* to concentrations above the standard, would be lower with NO_x controls than with the available VOC controls alone. Note that it might also be useful for areas with high ratios of VOC to NO_x concentrations (greater than about 12 to 1) to be included in this requirement, as theory suggests that controlling NO_x is likely to be especially effective for reducing ozone in these areas. Enhanced air quality modeling efforts are needed to produce a full evaluation of the impact of NO_x controls. However, as discussed in an earlier section on planning requirements, the limited number of people who know how to run state-of-the-art air quality models may pragmatically limit the number of areas that can be required to use them.

Controls in Upwind Areas

Discussion

Both ozone and its precursors, VOCs and NO_x, can be transported into nonattainment regions from upwind areas. Thus, some fraction of the ozone found in nonattainment areas is not subject to local regulatory authority. If the upwind area is also a nonattainment region, further control will take place to bring the area into attainment with the standard. However, if the upwind region already meets the standard, the only controls that can be expected are those that are federally mandated nationwide.

Thus, two issues may have to be addressed by Congress. First, current law does not provide an adequate mechanism to implement additional controls in selected areas that currently attain the standard, but contribute to ozone nonattainment problems in areas downwind. A similar limitation applies to requiring reductions in nonattainment areas. Current law does not include an adequate mechanism to force nonattainment areas to undertake emission reductions in excess of the amount required to attain the standard, even though the area might still be contributing to the nonattainment problem of another area downwind.

In chapter 5 we discuss which areas seem most likely to be significantly affected by pollutant transport from outside their region. The Eastern Seaboard, from Richmond to Maine, is the clearest situation of an interstate region that might require coordinated management. In the central part of the country, interstate transport is likely around Lake Michigan, and possibly between Cleveland and Erie, PA. In the South, transport appears likely in the coastal areas of Texas and Louisiana, and may also be contributing to nonattainment problems in parts of the Southeast. Finally, though within State borders, pollutant transport from one city to another is also a problem in central California.

Certainly some of these transport-related problems will be helped by the imposition of further controls in nonattainment cities. However, given the limits on the emissions reductions feasible with currently known control measures, many areas will

[14] If this option is chosen, it is important to be explicit about what is meant by the term 'beneficial, " because controlling NO_x can give mixed results. As a hypothetical but plausible example of the kinds of contrary outcomes that are possible NO_x controls could help lower peak ozone concentrations in a city from 0.18 ppm to 0.15 ppm, but at the same time increase the number of areas within a city where concentrations reach 0.13 ppm.

not be able to attain the standard in the near term. Moreover, in some regions (for example, the Southeast) much of the ozone transported into nonattainment cities may be originating from areas that meet the standard.

Unfortunately, it is easier to identify that a transport problem might exist than it is to identify solutions to the problem. The first question is which pollutant should be controlled, VOCS or NO_x? Next, one must attempt to define an appropriate control region size-e. g., 50 miles around nonattainment cities significantly affected by transport, whole States, or multi-State regions?

Theoretical considerations suggest that in most situations reducing NO_x emissions in attainment areas would either reduce ozone in nonattainment areas or have negligible effect, but would usually not be counterproductive. NO_x reductions in attainment areas would affect ozone concentrations in nonattainment areas by reducing ozone produced upwind. NO, controls in attainment areas would be expected to help reduce ozone in rural areas, as well as acid deposition.

NO_x itself is unlikely to be transported further than about 100 miles. However, our best guess of an upper bound to the distance over which major point sources of NO_x could have more than a negligible influence on downwind ozone is on the order of 300 miles-a distance over which ozone produced from the NO_x could be transported. We guess that aggregate emissions from mobile or area sources could have a similar scale of impact.

The relative amounts of NO_x emitted in attainment areas versus nonattainment areas varies significantly by region. In the Northeast, about 40 percent of the region's NO_x is emitted in attainment areas. In the South and Midwest, attainment areas contribute about 70 percent of regional NO_x emissions.

In 1985, about 60 percent of NO_x emissions in attainment areas came from stationary sources and 40 percent from mobile sources. By 2004, without further controls, we project the relative contributions to be about 65 percent from stationary sources and 35 percent from mobile sources.

Reducing manmade VOC emissions in attainment areas will either reduce ozone in nonattainment areas or have negligible effect. VOC emissions in attainment areas would affect nonattainment area ozone primarily by reducing VOCs transported into the area from upwind. Theory suggests that VOC controls in attainment areas could help reduce ozone in some rural areas, but would generally be less effective than NO_x controls. VOC controls would have a negligible effect on region-wide acid deposition levels. Note that in some parts of the country, less than half of the total VOC emissions in attainment areas are subject to control, as VOC emissions from vegetation exceed manmade emissions. As discussed in chapter 5, emissions from vegetation are especially high in the Southeast, but are also high in forested areas of the Northeast, Southwest, and Northwest.

Distances over which various volatile organic compounds can be transported range from a few miles to several hundred miles, depending on how quickly the individual compounds react away. However, the VOCs that travel farthest tend to be least efficient at producing ozone—so fresh emissions not only are more concentrated but are also likely to be more reactive than transported emissions. Our best guess of an upper bound distance over which VOCs from attainment areas would have an observable impact on ozone in downwind cities is on the order of 100 miles.

As with NO=, the proportion of VOCs emitted in attainment areas versus nonattainment areas varies by region. In the Northeast, about 40 percent of manmade VOCs are emitted in attainment areas. In the South, attainment areas contribute about 70 percent of manmade emissions. In the Midwest, attainment areas contribute about 60 percent of the region's manmade VOC emissions.

In 1985, about 50 percent of the manmade VOC emissions in attainment areas were from stationary sources and **50** percent were from mobile sources. By **2004,** without further control, we estimate that about 60 percent will come from stationary sources and 40 percent from mobile sources.

Options

Option 1: Enlarge nonattainment areas to include the entire extended metropolitan area.

In its proposed post-1987 policy, EPA suggested that ozone nonattainment areas be defined as including (at least) the entire "metropolitan statistical area" (MSA) or 'consolidated metropolitan statistical area" (CMSA) in which the ozone standard is violated.[15] The Washington, DC MSA, for example, extends over 100 miles, from the Pennsylvania border north of Frederick, MD; south and east to Solomons, VA on the Chesapeake Bay; and west to Middleburg, VA. In the past, some designated areas only encompassed the central urbanized city or county of the metropolitan area. Our analysis of emissions reductions has used MSA boundaries to define nonattainment areas.

Congress could adopt EPA's suggested new definition of an ozone nonattainment area. Or, Congress could further expand nonattainment areas out beyond MSA or CMSA boundaries. For purposes of reducing VOC emissions that may affect peak ozone concentrations within an urbanized area, an upper bound on how far nonattainment areas should be expanded is about 100 miles. Specified control requirements could automatically be applied throughout expanded areas. Alternatively, the States could be required to determine whether controls in these areas would be beneficial, with imposition left to their discretion.

Option 2: Congressionally specified NO_x controls in designated "transport regions" or nationwide.

Congress could require "reasonably available" control technology (RACT) for large stationary sources of NO_x in attainment areas as well as nonattainment areas. Again, Congress can be selective about where to require stationary source control measures. If the goal is to lower nonattainment area ozone concentrations, stationary source NO_x control requirements could be limited to States with or adjacent to nonattainment areas. Rural ozone impacts (discussed below) and acid deposition might also be considered in determining where stationary source NO_x controls should be required. Congress could allow the Administrator to exempt areas where he or she determines that stationary source NO_x controls would be ineffective.

Excluding States that do not have nonattainment areas, imposition of RACT-level standards for utility boilers in attainment areas would result in NO_x emissions reductions of about 15 percent below 1985 levels. RACT for other stationary sources in attainment areas would reduce emissions by an additional few percent.

Nationwide imposition of more stringent light-duty vehicle exhaust standards (discussed above) could result in about a 5-percent reduction in attainment area NO_x emissions.

Option 3: Strengthen the interstate transport provisions of the Clean Air Act.

Section 110(a)(2)(E) of the Clean Air Act requires that SIPS "prohibit any stationary source within the State from emitting any air pollutant in amounts which will prevent attainment or maintenance [of standards] by any other State. " Section 126 allows States or local areas to petition the Administrator for a finding that any major source violates section 110, and allows the Administrator 60 days after receipt of the petition to make the finding. Once such a finding is made, proposed sources are prevented from being constructed and existing sources must be brought into compliance within 3 years.[16]

To date, EPA has not issued regulations to establish what constitutes compliance with section 110, and has not granted any petitions under section 126, although some of the petitions filed have been resolved through the SIP or permit review processes. EPA has required petitioners to establish that an actual violation of an applicable standard has occurred, and that the out-of-state source is a ''significant" contributor to the violation. Claims have been required to be supported by monitoring data or modeling studies. But EPA has not considered the modeling techniques used to predict violations to be sufficiently reliable to demonstrate the connection between emitting and receiving regions or to distinguish local from interstate contributions.

Sections 110 and 126 of the Clean Air Act could be amended to define more clearly how much of an impact of one State's emissions on

[15] In addition, EPA has suggested that it will require that emissions from major point sources of VOC and NO_x located within 25 miles of the MSA or CMSA boundaries be included in the area's emissions inventory. This implies that these sources would be included in the agency's proposed area-wide average 3 percent per year VOC emissions reduction requirements.

[16] Section 126 & SO requires notification if a major proposed or existing source in one State may "significantly contribute" to levels of air pollution in excess of the NAAQS in another State.

another State's air quality is prohibited; to clarify where the burden lies in proving that an impact is or is not significant enough to take action against; and to specify factors that EPA should consider in determining what measures to require of the offending sources. Congress could broaden the applicability of the prohibition in section 110 from ''any stationary source" to include groups of sources-such as an upwind MSA or State-and then amend Section 126 accordingly. If Congress chooses to rely on mechanisms similar to those provided by sections lo and 126, the question of whether NO_x controls could be required when they might be counterproductive in the emitting State should be addressed explicitly.

Option 4: Provide EPA with clear authority to develop regional control strategies based on regional-scale modeling.

Over the past several years EPA has developed, and is currently working jointly with Northeastern States to apply, a regional-scale atmospheric model for the entire Northeast called the Regional Oxidant Model, or ROM. EPA proposes to use ROM, by the end of 1990, to test whether the independently developed, local attainment strategies of nonattainment areas in that region are adequate, or whether further emissions reductions are necessary. If the modeling analysis indicates that further controls are needed, EPA has proposed to use its authority to require SIP revisions to obtain them. While EPA ''does not anticipate the need for a regional model in areas outside the northeast region at the present time" [22], interstate transport may also be complicating the nonattainment problems of areas in the southern Lake Michigan and Gulf Coast regions.

Affirming EPA's proposed policy for the Northeast, Congress could require the Agency to apply regional-scale modeling in specified regions to ensure compliance with an amended section lo. The modifications to section 110 specified above would be applicable. Moreover, Congress could specify that once the modeling is completed, EPA is required to review all applicable SIPS. (A recent court interpretation of section lo holds that the section does not require reevaluation and revision of existing SIPS, unless the SIP is being revised for another reason.[17])

Several years and several million dollars would be required to develop programs for regions other than the Northeast. As mentioned above, the Gulf Coast, Southeast, and Great Lakes regions are potential candidates.

Reducing Ozone in Rural Attainment Areas

Discussion

Elevated concentrations of ozone occur in rural areas throughout the southern and eastern halves of the United States. Nationwide, reducing daytime, growing-season-average ozone concentrations by about 25 percent[18] in crop-producing areas is estimated to result in annual benefits from increased crop yields in the range of \$0.5 billion to \$1.0 billion per year. Reducing ozone concentrations outside of urban areas would also reduce damage to trees in national parks as well as commercial timberlands. However, the impacts of ozone on trees and on forest ecosystems are not understood well enough to support evaluation of the forest-related benefits of reducing ozone.

Rural ozone essentially has two sources, either of which could be a target for control-pollution that is transported from urban areas, and pollution that is produced locally. At present, there are no estimates of the comparative contributions of these two sources. Controls imposed in nonattainment areas (for VOC or VOC *and* NO_x) will help reduce ozone at rural sites impacted by urban "plumes" of elevated ozone concentrations. Such plumes have been observed to extend more than 200 miles downwind of some cities.

For reducing ozone produced locally, *outside* of urban areas, theory (including modeling exercises with hypothetical ''typical" rural conditions) suggests that NO_x control will generally be more beneficial than VOC control. Although they do not allow us to sort out benefits of urban versus nonurban controls, results from EPA's ROM sug-

[17] 852 F.2d 574 (D.C. Cir. 1988)

[18] In our analyses, we lower ozone concentrations by 25 percent of the difference between current levels and natural background.

gest that either controlling VOC emissions alone or controlling both VOC and NO_x emissions would help reduce ozone in rural areas in the Northeast.

Options

Option 1: Specify a deadline for EPA reconsideration of the ozone secondary standard for ozone and a schedule for adoption by the States.

The Clean Air Act establishes two types of air quality standards. "Primary" air quality standards are set by EPA to protect against adverse health effects. "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.

The secondary standard for ozone is currently set as a one-hour average concentration of 0.12 ppm, i.e., identical to the primary standard set to protect human health. The standard is under review by EPA, as it is generally thought to be poorly designed for protecting vegetation.

To date, definition of an appropriate secondary standard for ozone has been hampered by: 1) the preliminary status of assessment of its impact on forests; and 2) uncertainty about whether peak or long-term concentrations are most important in determining impacts on vegetation. Implementation of secondary standards for all of the criteria pollutants has been neglected, as evidenced by the scarcity of air quality monitors located in rural areas. Congress could direct EPA to put more effort into developing and enforcing a secondary standard for ozone.

Option 2: Congressionally specified NO_x controls.

We estimate that imposing more stringent light-duty vehicle exhaust standards nationwide would reduce NO_x emissions by a total of 1.3 million tons (7 percent of 1985 levels) in 2004, at a cost of $2.9 billion (for both NO_x and VOC controls).

Nationwide imposition of RACT-level standards for utility boilers in both attainment and nonattainment areas would result in NO_x emissions reductions of 3.7 million tons (about 20 percent of the nationwide 1985 *total)* in 2004. Nationwide RACT for other stationary sources would reduce emissions in 2004 by about 800,000 tons (4 percent) .[19]

Long-Term Control Strategies for Chronic Nonattainment Areas

Discussion

About half of the current nonattainment cities may require greater emissions reductions to attain the standard than are achievable with near-term control methods. Figure 6-12 displays our estimate of VOC emissions in 1994, after all of the controls discussed in chapter 6 have been applied. Note that emissions from solvents—surface coatings and many other sources of organic solvent evaporation-will account for about 35 percent of the remaining inventory. Highway vehicles and the gas stations that fill them will account for an additional 35 percent.

Longer term strategies to bring the remaining nonattainment areas into compliance with the standard will have to include one or both of these emissions categories-and in some cities, progress in other categories as well. Within this section we consider three possible targets of opportunity for post-2000 emission reductions. These include: ways to lower organic solvent emissions, long-term transportation control measures, and use of alternative motor vehicle fuels such as methanol and compressed natural gas (CNG). Each of these was discussed in detail in chapter 7.

Options

Option 1: Lowering emissions from solvents.

As described in chapter 7, organic solvents are used in a myriad of products and manufacturing processes. They are used to clean many types of products, from decreasing metals to drycleaning fine

[19] The majority of these reductions (56 percent) would occur in the South;17 percent would occur in the Midwest;and 9 percent would occur in the Northeast.

clothing; to deliver surface coatings, including house paints, printing inks, and coatings on many manufactured products from cans to furniture to magnetic tape; and in consumer products such as pesticides and deodorants.

Solvent emissions can be lowered in many ways. In some instances it is possible to switch to alternative products that use no solvent (for example, using water-based rather than oil-based paints). Products can be reformulated so that less solvent is used or solvents that are not photochemically reactive are substituted for those that are involved in ozone formation. Manufacturing methods can be changed so that less solvent is emitted per unit manufactured. And finally, emissions can be captured or destroyed through control methods such as incineration, preventing release to the atmosphere.

However, for many products and processes, low or no-solvent alternatives are not available and alternative manufacturing methods may not deliver the desired quality end product. Thus, unlike for many other source categories for which significant reductions can be achieved by applying "reasonably available control methods" or "best available control methods," the problem of solvent emission reduction faced by Congress, EPA, and the States is to force the development of new products, manufacturing processes and control methods.

This problem is not without precedent. When Congress directed EPA in 1970 to develop regulations that lowered motor vehicle emissions by 90 percent, the technology to achieve this was not available. Congress decided to force development of technology by choosing a percentage reduction target and a date by which it was to be reached, and by adopting penalties to provide additional incentives for manufacturers to develop technologies that would comply with the new law. Deadlines were slipped many times and several have yet to be reached, but tailpipe emissions of VOC, nitrogen oxides, and carbon monoxide have been lowered considerably.

We have identified three basic approaches that Congress can take to facilitate reductions in solvent-related emissions and promote innovative approaches to achieve these reductions:

1) *Direct EPA to issue "reasonably available control measures" for specified solvent uses and source sizes.* Some categories for which Federal guidance or regulations could be issued in the near future were discussed in earlier sections of this chapter. Under this option, EPA would be directed to continue developing control technique guidelines (CTGs) for new categories of sources or develop Federal regulations that apply nationwide. In some instances, size cutoffs could be lowered from current levels or eliminated altogether.

2) *Direct EPA or the States to issue regulations to lower solvent-related emissions by a specified percentage by a certain date.* Rather than specifying particular solvent uses, Congress could specify the desired emissions reduction schedule and leave the choice of solvent uses to be regulated to either EPA or the States.

3) *Provide clear authority in the Clean Air Act for EPA or the States to use a market-based approach for controlling emissions and, in the latter case, direct EPA to provide model regulations as guidance for the States.* Two basic approaches would either: 1) impose fees or surcharges on emissions or products with high solvent content, making the fees high enough so that it is cheaper to control emissions or find substitutes than to pay them; or 2) distribute permits to producers or users that allow them to emit a specified amount of VOCs, and then cut back gradually on the permitted levels. Trades would be allowed among sources so that those who could reduce emissions at the least cost could reduce more than required, and "sell" their extra reductions to others for whom reductions were more expensive.

Of the three options listed above, the market-based strategy deviates most from traditional control approaches. We did not evaluate whether fees or permits or some variation of these approaches would be best suited to VOC or solvent regulation. Nor did we analyze in detail the advantages and disadvantages of market-based approaches compared to more traditional regulatory systems in which EPA or State engineers identify available control technology for specific source categories and require those sources either to use them or match the reductions obtained with them by using other measures. However, market-based approaches seem to offer enough promise for cutting costs and promoting development of new ways to reduce emissions that Congress might choose to direct EPA to seriously evaluate their use for lowering solvent-related emissions.

Though the Clean Air Act does not preclude the use of market incentives, most of the Act is devoted to establishing a regulatory system based on the traditional "engineering" approach. By clearly stating its intent that market-based approaches are acceptable, Congress could at least allow them to be considered on their merits. If Congress decides that a market-based strategy is the preferred approach, then EPA could be required to develop model regulations for the States to adopt.

Option 2: Long-term transportation control measures.

The 1988 Air Quality Maintenance Plan for Los Angeles estimates that by 2010, highway vehicle emissions could be reduced by 30 percent below where they otherwise are projected to be, by using a suite of complementary transportation control measures ranging from parking management to highway expansion to telecommuting. Total daily reductions anticipated in 2010 are 10 times higher than those expected from the program in 1994, as measures focused on new businesses or developments take effect, and as freeway expansion projects are completed. Growth management measures aimed at matching new jobs with nearby housing account for about 40 percent of the reductions projected for 2010, but have negligible impact in 1994. These measures entail assessing development fees, modifying zoning rules, and policies for location of new public facilities and infrastructure. An additional 15 percent of the expected reductions would come from freeway capacity enhancements to reduce congestion.

Of the remaining measures, about 30 percent of the reductions come from a series of measures aimed at lowering highway vehicle usage. These are primarily strategies to reduce the number of single-occupancy car trips, including employer ride share and mass transit incentives, parking management (increase parking meter fees, eliminate peak-period on-street parking, eliminate employer-subsidized parking, etc.), van pool purchase incentives, auto use restrictions, and high-occupancy vehicle (HOV) lanes. About 15 percent of the reductions come from measures that do not lower vehicle usage but rather reduce congestion. Reducing congestion decreases the number of hours that vehicles are on the road and thus lowers emissions. These include such measures as traffic flow improvements (e.g., metering on highway ramps, synchronized traffic signals, and intersection improvements) and rescheduling and rerouting of truck deliveries away from congested areas during peak commute hours.

For Los Angeles, such reductions would occur at a crucial period. Highway vehicle emissions are forecast to drop over the next 10 years due to the replacement of older cars and trucks with more stringently controlled ones. After 2000, however, emissions are forecast to rise again due to population growth. The hoped for 30-percent reduction due to transportation control measures is enough to more than offset the expected emissions growth between 2000 and 2010, keeping highway vehicle emissions on a slight downward trend.

The potential for reducing emissions appears greatest if TCMs are viewed as long-term programs. To guide SIP revisions likely to be required in the interim, areas could be required to develop TCM programs over 15- to 20-year time horizons and include them in urban transportation and land-use plans. Periodic updates would accommodate changes in development patterns and transportation requirements, etc.

In addition to requiring that States use TCMs, Congress may want to require that air quality objectives are given higher priority in federally funded urban transportation projects. Section 176(c) of the 1977 Amendments was an attempt to provide a check on the air quality impacts of all projects supported by Federal highway and mass transit funds by requiring that federally funded projects "conform" to State Implementation Plans. However, DOT, which distributes Federal highway and mass transit assistance, has sought to equate ''conformance" with a narrow finding that a transportation plan or project does not interfere with transportation control measures included in SIPs [19]. EPA has suggested a broader requirement that transportation plans and projects "should not cause or contribute to existing or new standard violations, or delay attainment" [3]. Congress could clarify or strengthen the conformance requirements of section 176(c) to support EPA's interpretation.

Option 3: Requirements for widespread use of alternative fuels in nonattainment areas that are far from meeting the standard.

We estimate that for every 25 percent of light-duty vehicles using alternative fuels in 2004, VOC emissions would effectively be reduced by 1.5 to 4 percent, compared to 1985 levels. The lower level of reductions is our best estimate. Achieving greater reductions from alternative fuels would require exclusive use of methanol or compressed natural gas in each vehicle, as opposed to use of methanol/gasoline blends or vehicles that could run on gasoline *or* alternative fuels. Achieving the greater reduction levels would also require *significant* advances in vehicle technology, and vehicle designs and operating parameter adjustments to ensure minimal emissions.

Assuming that methanol blended with 15 percent gasoline is used, and the lower levels of reductions cited above are achieved, we estimate that costs would be $8,700 to $66,000 per ton of VOCs reduced. Assuming use of CNG 75 percent of the time and use of gasoline for the remaining 25 percent, cost-effectiveness would fall in the range of $3,900 to $22,000 per ton. If the upper bound level of reductions can be achieved, the cost of using straight methanol could be as low as $3,200 to $22,000 per ton. Exclusive use of CNG could result in costs between $1,600 to $14,000 per ton. In each case, costs are extremely sensitive to fuel prices.

Obviously, for vehicles in general use to operate on CNG or methanol, both vehicles and fuel have to be made available. Establishing fuel production capacity, fuel distribution networks, and motor vehicle production lines entails major investments, and simultaneous and appropriately scaled commitments are needed in each area. Current estimates of the economics of using alternative fuels, compared to gasoline, suggest that either subsidies or mandates from Federal or State government will be needed if alternative fuels are to be used in general service in the next 10 to 15 years.

Using California as an example, a fixed percentage of each major automobile manufacturer's new vehicle sales in the State might be required to be either CNG or methanol fueled. Vehicle registration fees or tax credits could be used to equalize the cost of alternative and gasoline-fueled vehicles. Similarly, fuel retailers could be required to offer alternative fuels at a fixed percentage of their stations, and gasoline taxes could be set to about $0.25 to $0.50 per gallon to allow methanol to compete with gasoline on a cents per mile basis.

Flexibly fueled vehicles that can run on methanol or gasoline or any combination of the two, and dual-fueled CNG vehicles that can run on gasoline or CNG, would be easier to introduce into general service than vehicles operated exclusively on CNG or methanol, because they could be operated out of range of refueling stations that supplied the alternative fuels. Where improvements in air quality are the major motivation for using alternative fuels, however, these vehicles have two disadvantages: low emissions that might be possible with the alternative fuels would be compromised to provide for satisfactory operation on multiple fuels; and consumers might simply choose not to operate them on the alternative fuel. The second problem could be addressed by using taxes or subsidies to encourage alternative fuel use. The first problem suggests that flexibly or dual-fueled vehicles should only be viewed as a transition measure.

In addition to developing the necessary infrastructure, government intervention may be needed to increase the likelihood that low emission rates can be realized, so that from an air quality standpoint, alternative fuels will be worth the investment. This could take the form of government-funded research and development efforts. Alternatively, manufacturers could be required to produce a fixed percentage of vehicles meeting *new,* technology forcing emissions standards, but be given the flexibility of meeting them using any vehicle technology they choose. EPA would be given the task of defining equivalent emission rates—based on ozone forming potential—of gasoline-, methanol- and CNG-fueled vehicles.

The Los Angeles area Air Quality Management District has already adopted the goal that by the year 2000, at least 15 to 30 percent of the motor vehicles in the area should be "clean fuel" vehicles [12]. To date, however, the district has not set forth its strategy for meeting that goal.

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