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AIR QUALITY MAINTENANCE: PROPOSED LEGISLATION AND ANALYTICAL ISSUES

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ABSTRACT

An important area of recent environmental concern is the issue of non-significant deterioration of air quality in pristene areas. This paper summarizes and compares current legislative and regulatory agency thinking and notes the relative restrictiveness of three proposed plans dealing with the issue of non-deterioration. Following this exploration into expected legislative directions, the critical analytical questions about which more information is needed are raised. In view of these latter considerations, with particular emphasis on urban-nonurban environmental tradeoffs, it is concluded that the policy issue of deteriorating pristene environments will be with us for many years.

Introduction

Air quality nondegradation has recently become a controversial area of concern and promises to become still more hotly debated in the years to come. This paper explores the current legislative thinking in this area and raises the critical analytical issues about which more information is needed. If precisely enforced, a policy of literal nondegradation of air quality would restrict population and employment growth severely in sparsely populated areas. In practice, a strict policy of nondegradation cannot be justified in all sparsely populated areas. As a consequence, a concept known as significant deterioration has been developed which specifies a

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maximum allowable increment in pollution due to a new source. This allowable increment may vary by location depending on the costs and benefits of allowing degradation of air quality at that point in space.

Certain natural resources, historic sites, and wildlife are more valuable socially than is indicated in the private sector valuations. In cases where such externalities exist, greater protection from depletion, damage, or extinction due to air quality deterioration is warranted than would be forthcoming from the private sector. Acting on this presumption, Congress has been developing legislation to provide a greater level of protection of air quality for these natural resources which are presently protected from land use encroachment within national parks or wilderness areas.

The second section reviews and compares the nonsignificant deterioration plans of the Senate, House and EPA. The next section considers analytical issues raised by all of these plans and suggests areas in which decision-making will be seriously hampered by lack of knowledge. The last section summarizes and concludes.

Current Legislative Direction

The development of legislation in this area has been spurred by the courts and by the former administration. The courts interpreted the phrase,

> . . . to protect and enhance the quality of the nation's air resources in order to promote the public health and welfare and the productive capacity of its population . . .

from the 1967 Clean Air Act as requiring the EPA to adopt some form of nondegradation regulation. This resulted in the promulgation by the EPA on January 6, 1975 of currently applicable regulations to prevent significant deterioration of air quality.

Because of concern for the effect of these regulations on energy production, the Administration asked Congress to consider, as part of the Energy Independence Act of 1975, alternatives to significant deterioration regulation proposed by the EPA. In response to this request, on March 29, 1976, both House and Senate committees simultaneously released proposals which called for yet more restrictive significant deterioration amendments to the Clean Air Act [1, 2]. As a result of an administration threat of a veto and of controversy within the Congress itself, no action was taken on these amendments in the last 1976 legislative session.

In order to evaluate the relative desirability of the House

(H. R. 10498), Senate (S. 3219), or EPA regulation, a brief comparison of the three proposals is presented in Tables 1 and 2. The three are similar in that they provide a degree of flexibility to alter the severity of the regulation at various locations for either environmental or economic reasons. However, there are substantial differences in terms of initial stringency of regulation and definition of who is responsible for adjustments. The House and Senate bills both commit the federal government to protect rare natural environments on specified federal lands. The EPA regulation permits states to provide similar protection but at the state's discretion. The House bill most restricts economic growth in protecting the environment while the EPA regulation is least restrictive.

All three proposals endeavor to provide environmental protection of varying stringency by establishing different classes of areas as outlined in Table 1. Class I exists for the protection of pristine areas. Class II places loose restrictions on growth of pollutant concentration due to a single stationary source up to a specified maximum concentration. This maximum is at or slightly below certain National Ambient Air Quality Standards (NAAQS). In the EPA regulation and House bill a Class III is defined which places loosest restrictions of all on growth in concentrations while retaining the same maximum concentrations. An EPA study of the three indicates that Class II status will allow growth of all currently planned industries [3]. The study anticipates the need for a Class III after 1980 to permit large scale industrial or energy parks or coal gasification plants in the hilly Appalachian coal fields. The weak point of the study is that it is based *only* on sulfur dioxide concentrations.

The absence of a Class III from the Senate bill appears to make it relatively restrictive. The effect of this absence would be to reduce the allowable size of energy facilities in areas where air is currently clean—primarily rural areas. The House bill, however, is more restrictive because of its addition of ozone, nitrogen dioxide, and carbon monoxide to the list of covered pollutants, as seen in Table 1.

This addition to the House bill is consistent with its general approach. The House bill appears stringent and inflexible in its regulations with little consideration of the net social benefits. Thus the House regulations include restrictions on ozone concentration growth when the exact causes of ozone are not well understood. It also defines ninety-eight areas as Class I without allowing adjustments to this classification. The Senate bill is more cautious,

Table 1. Classes and Allowable Increments Under EPA, Senate and House Significant Deterioration Policies

Actor	*Pollutant*	*Class I*	*Class II*	*Class III*
ENVIRONMENTAL	Particulate matter:			
PROTECTION	Annual geometric term	5 ug/m^3	10 ug/m^3	
AGENCY	24 hr. maximum	10 ug/m^3	30 ug/m^3	UP TO THE
	Sulfur Dioxide			NATIONAL
	Annual arithmetic mean	2 ug/m^3	15 ug/m^3	AMBIENT AIR
	24 hr. maximum	5 ug/m^3	100 ug/m^3	QUALITY
	3 hr. maximum	25 ug/m^3	700 ug/m^3	STANDARD
SENATE	Particulate matter:			NO
(S. 3219)	Annual geometric mean	5 ug/m^3	10 ug/m^3	SUCH
	24 hr. maximum	10 ug/m^3	30 ug/m^3	CLASS
	Sulfur Dioxide			
	Annual arithmetic mean	2 ug/m^3	15 ug/m^3	NO
	24 hr. maximum	5 ug/m^3	100 ug/m^3	SUCH
	3 hr. maximum	25 ug/m^3	700 ug/m^3	CLASS
HOUSE	Particulate matter:	10% OF	25% OF	50% OF
(H. R. 10498)	Sulfur Dioxide:	2% LOWEST	25% LOWEST	50% LOWEST
	Nitrogen Dioxide:	2% APPLI-	25% APPLI-	50% APPLI-
	Carbon Monoxide:	2% CABLE	25% CABLE	50% CABLE
	Ozone:	2% STAND-	25% STAND-	50% STAND-
		ARD	ARD	ARD

Table 2. Attributes of Three Significant Deterioration Alternatives

Actor	*Areas initially declared class I*	*Reclassification or class modification opportunities*	*Covered industries total*	*Pollutants included*
EPA	None	State may reclassify	19	Particulates Sulfur Dioxide
Senate (S. 3219)	*130 Areas* (> 6000 acres) National Parks (> 5000 acres) International Parks National Wilderness Areas National Memorial Park	State may reclassify other than federal lands. State and federal land manager reclassify federal lands not listed on left. Class I limits may be modified by demonstration of level of impact.	28	Particulates Sulfur Dioxide
House (H. R. 10498)	*98 Areas* > 25000 Acres National Parks National Wilderness Areas *Other Areas* (> 1000 Acres) National Parks National Wilderness Areas International Parks (> 10,000 Acres) National Preserves, Monuments, Recreation Areas, or Primitive Areas	State may reclassify federal lands shown on left as *Other Areas* and all non-federal lands. No Class I modifications for *98* Areas on left.	*All* over 100 tons/yr.	Particulates Sulfur Dioxide Nitrogen Dioxide Carbon Monoxide Ozone

since it only regulates particulates and sulfur dioxide, both of which are relatively well understood. It calls for study of nitrogen oxides and hydrocarbon emitters. Similarly, in its Class I classification scheme the Senate bill merely commits the federal government to study the desirability of Class I restrictions for 130 federally owned areas. Class I restrictions on new industry adjacent to these 130 areas will apply only if justified by study. In the House version, Class I restrictions apply automatically. The EPA regulation, however, commits no one to study the desirability of Class I restrictions anywhere, nor does it specify any area as worthy of a Class I designation. It merely defines all areas as Class II and *allows* the states to reclassify areas to Class I or III subject to procedural rules. (See Table 2.)

The three proposed approaches by which industry is to be designated for control follow the same pattern of stringency. The House bill lists *any* stationary source which directly emits or has the design capacity to emit one hundred tons per year for all pollutants for which NAAQS are established. The Senate bill lists twenty-eight specific industries on a control list while the EPA require a determination of the pollution generating characteristics of an industry before it enters a control list. In the House bill a new technology will not escape legal control requirements simply because the EPA does not yet recognize it as a major polluter.

Theoretical Issues

GENERAL CONSIDERATIONS

The consideration of air quality maintenance issues, more than perhaps any other area of environmental policy, requires the incorporation of interdisciplinary input. The nature of the uncompensated externalities which imply intervention in the market process are very subtle, calling for the expertise of plant, animal, and ecological-interactive experts in addition to the more usual skills of economists and engineers.

However, taking negative externalities to be synonymous with the environmental problem at which the air quality maintenance legislation is aimed is a very useful and appropriate approach. In this way implications from earlier environmental work can be brought to bear on the nondegradation issue.

The causal relationships which have been brought together in the best previous work evaluating environmental policies are summarized in Figure 1. That the issue of non-degradation is ignored in this

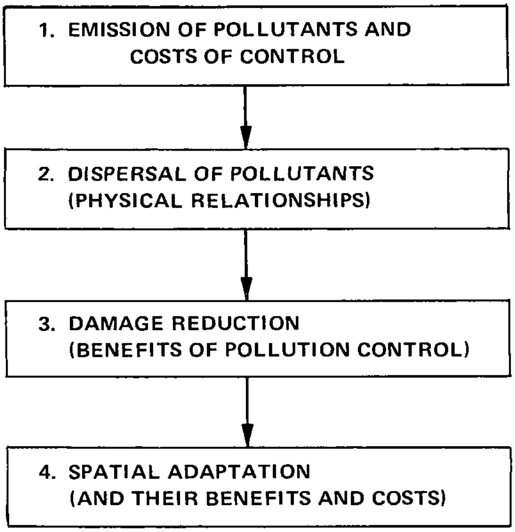

Figure 1. Evaluating environmental policies, nondegradation ignored.

scheme is manifest in the behavior associated with Box 4, Figure 1, the spatial adaptation option. This locational option is, from the usual analysis, very appealing since most pollution damages are related to density. That is, in urban areas any given pollution emission source will do more human and property damage simply because more people and their appurtenances are present to be damaged. Hence the mortality, morbidity, soiling and corrosion damages are far larger in urban areas. At the same time, plant and wildlife damage is minimal in urban areas where pollution is greatest for converse reasons. As a result, much work on the quantification of pollution damages and the construction of appropriate policies to deal with these damages has essentially ignored the non-urban damaged receptors—the pristine wildlife environment. This latter concern is the motivating influence behind the various air quality maintenance strategies.

Unfortunately, as Figure 1 brings out, the policy implications of the two areas of concern—urban and pristine environments—are opposed to one another. From the perspective of the urban environmentalist a firm relocating from an urban to a rural area is usually making a socially desirable move since the human and material externalities would be far lower there. The wildlife and conservation oriented environmentalist would, however, find such a move abhorrent.

Clearly, specific instances can be constructed in which one concern vastly outweighs another. An extremely rare natural environment (e.g., the everglades, various estuarial breeding grounds) would be in society's interests to preserve for the immense potential scientific enrichment and for the preservation of social "option demands" for later observation and use by posterity. At the other extreme, a tract of mid-Western corn land, in all respects like millions of others, may be a perfect location for a producer who would otherwise damage hundreds of thousands of people in a large urban environment. Environmentalists of all stripes would likely agree on the appropriate regulations for such extreme cases as this. Other examples become far less clear and important trade-offs must be made.

In summary, encouraging heavy polluters to locate away from dense populations appears socially desirable from the perspective of direct human damage and in many cases the social net benefits of this sort of relocation are far higher than would result from pollution control devices in place. Yet, such encouragement can damage mankind indirectly through loss of irreplaceable environments and the species they support.

KNOWLEDGE NEEDED

The most pronounced weaknesses from a benefit-cost decision maker's perspective in the EPA analysis [3] of the impacts of the House and Senate Bills are:

1. on the cost side, atmospheric dispersion modelling of sulfur oxides dispersion has been relied on almost exclusively, with the economic substitutions analyzed incompletely [4]. Variable costs have been ignored and much of the results are misleading.
2. on the benefit side, almost nothing has been done [5, 6].

The difficulties expressed in 1. are not theoretically complex in that just careful work should result in far better cost estimates. On the benefit side, however, the state of knowledge is deficient at both the theoretical and empirical levels. These difficulties relate to:

1. nonlinearity of damages,
2. threshhold effects,
3. diversity of damage according to plant, animal, and pollutant type,
4. marginal valuation of endangered species as it relates to species population, and

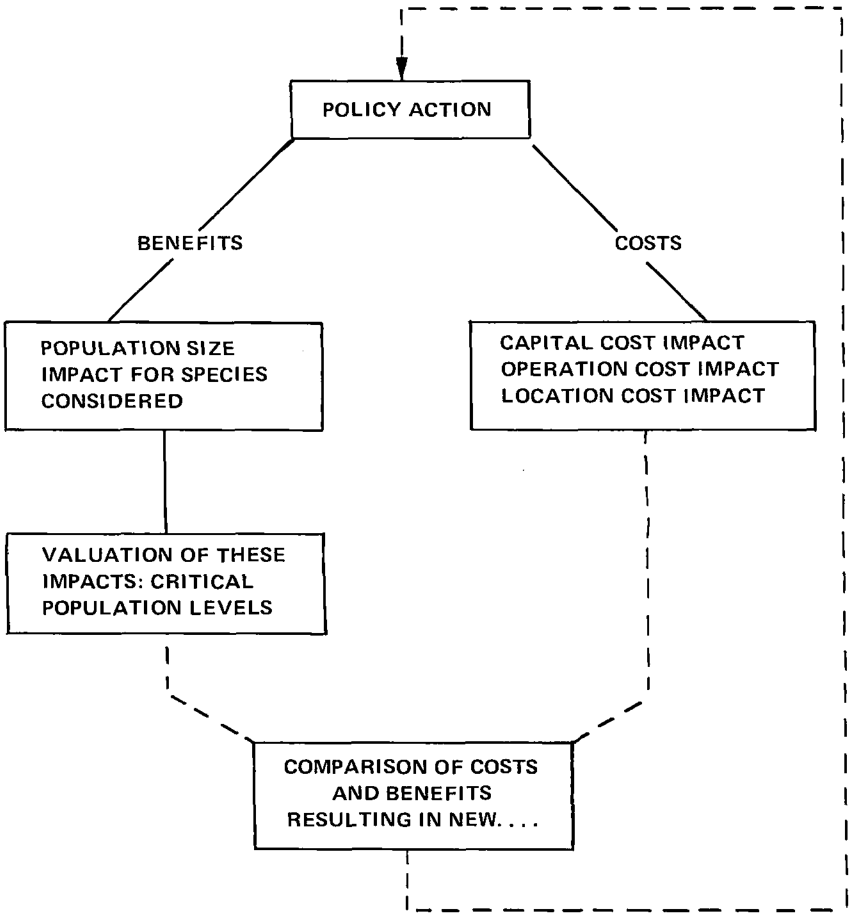

Figure 2.

5. the indirect ecological implications (e.g., loss of critical link in food chain).

More than is currently available must be known in all these areas before even "ball-park" benefit-cost calculations can be made. These five areas are considered in greater detail in the paragraphs to follow. (See Figure 2.)

Whether damages rise proportionally or more than proportionally to increases in pollution has important implications for clustering of firms. To see this, suppose the population at risk is uniformly distributed over a space containing two polluting plants. If the

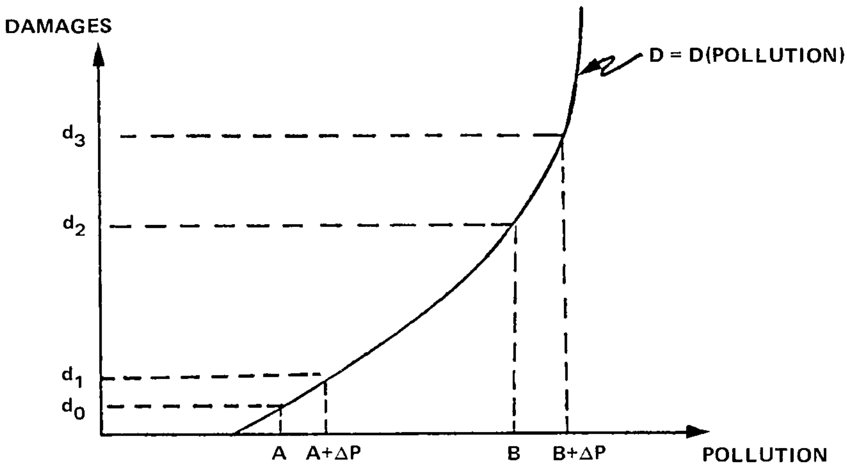

Figure 3. Nonlinearity implications for nondeterioration.

plants are located quite far apart approximately twice as many people are damaged but each received about half as much pollution as would be the case if the plants were located side by side. If damages are proportional to pollution over the relevant pollution range, damages are the same in either configuration. Yet many studies indicate that damages often rise more than in proportion to pollution increases over relevant ranges. The implications of this point relate critically to the air quality maintenance issue. Suppose damages rise as depicted in Figure 3 with pollution. Then suppose a new plant comes into existence which would add ΔP to the level of air pollution surrounding it. If the plant is located where current pollution levels are low (A in Figure 3) the incremental damages are small; if however it is located where pollution levels are already high the incremental damages are much larger. This is a further reason, *ceteris paribus*, for an initial reaction against the air quality maintenance notion—not only are more people present to be damaged in urban areas, but non-linearities in pollution damage indicates that they are damaged, from new sources, by a relatively greater incremental amount.

The *ceteris paribus* assumption above is, however, at the center of the debate—if the only populations affected by pollution, (or, alternatively, the only populations we care about) are human, then the foregoing argument would generate little controversy.

Closely related to non-linearities are threshhold effects, levels of pollution below which no damage occurs. If this consideration is important, then the level of the threshhold (and the nature of relative non-linearities) by plant and animal species becomes crucial information in evaluating air quality maintenance policies. If a species, particularly an endangered one, has a very low pollution threshhold the concept of maintaining air quality in pristine areas becomes quite attractive. Some work has been undertaken along the lines suggested here. Mice, guinea pigs, and rats are ordered in increasing order of their tolerance to SO_2 [7]. Thomas and Hill calculated SO_2 resistance factors for over 300 plants [8]. However, for the species of greatest social concern due to fear of extinction little is known. Further, such analysis would be necessary for a wide variety of pollutant types. A particular endangered species may appear very tolerant to say, sulphur dioxide and carbon monoxide, but very low levels of ozone or peroxyacyl nitrates might prove fatal. It is likely that such radically different relative pollution tolerances would be common. Unfortunately, far too little research has been done in this area. Further complications arise in noting that controlled tests on all specific pollutants may indicate insignificant effects when, in synergistic combination, significant damage may take place. Again not much is known, except that such possibilities are likely.

Finally, the marginal social valuation of endangered species as it relates to species population is a critically underinvestigated area which bears importantly on the non-degradation issue. That is, from a social standpoint the importance of the loss due to pollution (or whatever reason) of a particular individual animal or plant depends in all cases on how many would be left. As a working hypothesis, the relation between the marginal value of an individual of a species and the total number remaining is as depicted in Figure 4. This figure depicts three important facts. First, each species population has a critical level below which the population cannot reproduce itself. (POP_{min} in Figure 4.) Second, as the actual population falls toward this minimum reproducible population, the marginal social valuation rises (as at MV_A in Figure 4) on individual members of this species (asymptoting to infinity at POP_{min} if we feel that the species should definitely not be lost to mankind). Finally, however, it is noted that the marginal social valuation may become quite small for populations significantly above the reproducible population, as at point B. Hence, we greatly value Kodiak bears or rattlesnakes, but we don't want too many of them! (MV in Figure 4 can easily become negative for large populations.)

As with the earlier considerations, however, a great deal is known about the general shape of the MV relation, but almost nothing is known specific to the various species of importance.

Related to this point is the weakness in the existing knowledge

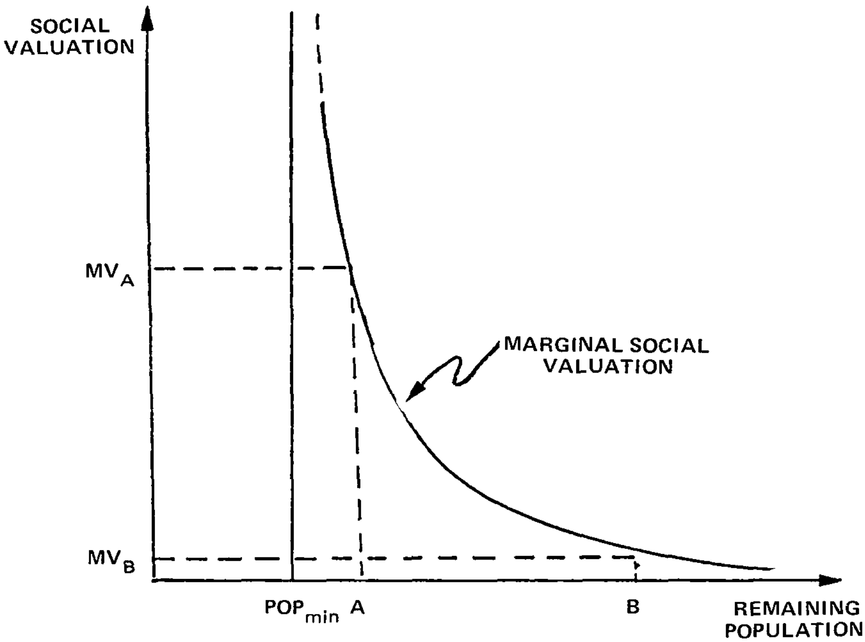

Figure 4. Social value and population relationship.

of ecological interaction. A species which is of concern may not hypothetically be harmed by the pollutants considered in the Senate, House or EPA proposals. But if some ecological agent which is vital to the maintenance of the species of concern is damaged, the latter species may suffer important indirect harm. These interrelations will not be captured in laboratory experiments of the usual sort. The analysis required for these indirect effects suggests the importance of the input of a biological expert in an interdisciplinary effort.

In this discussion of damages and knowledge requirements the emphasis has been on living organisms. Soiling, corrosion and related damages due to pollution on historical buildings, memorials and the like are conceptually easier to analyze and much more information is available.

Summary and Suggested Policy

As outlined critical gaps in present knowledge must be filled before any rational policies can be advanced. The areas in which this knowledge is needed most, vitally are:

1. Damages, by pollution type, for a potentially long list of specific plant and animal kinds.
2. Critical population levels for these same species.

This would enable the decision making approach in Figure 2 to be utilized. The impact of a particular policy action on capital, operation and locational costs are calculated. A policy may well result in the prohibition of certain lowest cost locations when such locations endanger important species—hence the differences in costs due to a less preferred location must be considered explicitly. These are compared to the benefits—which for some policies will be small and others large—and the policy will then be found to have benefits greater than costs (all appropriately discounted) or it will not. The comparison will result in policy revision as depicted in Figure 2.

An important distinction must be drawn at this point. Only the air quality implications of industrial expansion have been discussed here. A non-polluting firm could, even with air quality maintenance regulations, locate near a pristine area and, in the process, destroy it. It sometimes appears that the underlying motivation behind air quality maintenance proposals is to prevent all growth-induced relocations, regardless of the air pollution impacts involved. While this may be a legitimate motive in its own right, it should not masquerade in other guises. It is in many cases clear that pollution results in far less damage to unspoiled areas than occurs from the encroachment of human civilization *per se*. But this fact, if importantly related to demands for air quality maintenance, argues perhaps for direct land use controls (various forms of zoning and other restraints) and not imposition of socially undesirable restraints on where pollution takes place.

Of the three alternative proposals described, the Senate version appears most attractive. However, based on the theoretical considerations and knowledge gaps outlined, it would appear that appropriate legislation in this area has not yet been drafted.

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