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THE TIME DIMENSION IN ENVIRONMENTAL LEGISLATION

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ABSTRACT

Many of the current environmental legislations include specific deadlines for meeting environmental standards. It has been argued that some of the deadlines are unreasonable, as they evidence little regard for economic and social costs. There have already been a couple of occasions where such deadlines have been suspended or postponed, after lively debate. It is possible that there will be more such debate in the near future regarding the further postponement of these deadlines and the suspension of other deadlines.

What are the environmental costs of postponing deadlines? What are the economic and social costs of imposing early deadlines? How do we balance these costs as we consider setting deadlines in environmental legislation? These are the kind of questions to which this paper will be addressed. Specifically, the paper will attempt to illuminate the time dimension issue in its environmental context, to review the past research related to the issue, to discuss the significance of the problem, and to suggest policy-oriented research in this area.

Problem Analysis and Illustration

The environmental movement is so pervasive that there is hardly a major sector in our society and hardly a major discipline or profession that is not involved in or by the movement [1]. However,

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the specific questions of cost balancing or tradeoffs raised previously are typical questions in economics. It behooves us, therefore, to begin with the most basic concept upon which most economists tend to anchor their views on environmental issues, namely the concept of externality [2, 3]. When side effects are generated in a production or consumption process, such as unintentional generation of pollution, the actions of one person or firm cause a cost to be borne at least partly by others. This shared or imposed cost is referred to as an external diseconomy. Because in such a situation not all of the actual cost is borne by the polluting person or firm, the market mechanism alone will fail to produce the best allocation of resources. Ralph Turvey pointed out that there are four ways of dealing with externality [4]:

1. Regulation by public authorities, e.g., prohibiting the use of certain fuels or requiring that effluents meet certain emission standards;
2. Contract between the party that causes (gainer) and the party that bears (loser) external effects, usually with payments by one to the other in the form of legally enforced compensation by the gainer to the loser, or a bribe to the loser from the gainer;
3. Taxes imposed by the public authorities at a rate supposedly commensurate with the external diseconomy, or excess of social (total) cost over private cost; and
4. Internalizing the externalities by centralizing decision making for the group of units whose activities have external effects on each other.

Each of the above four ways of dealing with externality has pros and cons. However, since regulations are relatively easy to police, relatively simple for the public to understand, and serve to put very clear-cut legal and moral pressure on polluters, current environmental legislation has tended to use regulation predominantly to deal with environmental externality. Yet regulations themselves are distortions of the market process, and as such have side effects or externalities, such as increased production costs, transitional unemployment, and the aggravation of one kind of environmental problem while alleviating another. Often the social costs of a regulation are dependent upon the corresponding deadline, since the degree of disruption of the market process increases with decreasing time allowed for market response. Thus the consideration of deadline in regulatory environmental legislation should involve the trading off of all social costs of market disruption against the social benefits of alleviating negative environmental externalities.

While there have been a variety of environmental laws enacted in the recent past, perhaps the most important ones are the Clean Air Amendments of 1970 and the Federal Water Pollution Control Act Amendments of 1972. In the case of the Federal Water Pollution Control Act, deadlines are explicit, while the specific physical environmental standards to be met by those deadlines are left for the Environmental Protection Agency (EPA) to set. For example, paragraph 301 (b) (1) (A) reads in part: "In order to carry out the objective of this act there shall be achieved not later than July 1, 1977, effluent limitations for point sources . . . which shall require the application of the best practicable control technology currently available as defined by the Administrator [of EPA]. . . ." This sort of legislation leaves ample room for the comprehensive consideration of all costs and benefits in the setting of environmental standards for the stipulated deadline. The effect of this legislation will be to ensure that all potential polluters employ the best practicable pollution control technology.

The Clean Air Amendments, on the other hand, offer a significantly different and far more complex set of stipulations. The automobile emissions section of the legislation allows the Administrator (of EPA) to set both emissions standards and the corresponding deadlines. Those deadlines are to be set to allow as much time "as the Administrator finds necessary to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance within such period." However, the legislation went on to stipulate (before subsequent amendments) that those standards had to require by the 1975 model year a reduction from the 1970 levels of at least 90 percent in hydrocarbon (HC) and carbon monoxide (CO) emissions. They also had to require by the 1976 model year an at least 90 per cent reduction in oxides of nitrogen (NO_x) emissions from those levels measured in 1971 model year vehicles. But those deadlines could be suspended for one year if the Administrator determined that certain criteria were met. In fact, such a suspension was granted for the 1975 HC and CO standards by the then EPA Administrator Ruckelshaus. As he explained in his April 1973 decision, the 90 per cent reduction standards would require catalytic converters, and there was reason to believe that the conversion of all car production at once to include catalytic converters would cause severe economic problems due to initial production difficulties. Consequently, Ruckelshaus decided to set interim standards for 1975 that would require catalytic converters on all cars in California, and only a few models in the rest of the nation. In this way the manufacturers would be forced to gain

experience in working with the converters, without having to revise their entire production operations [5]. (It is of interest to note that certain manufacturers used catalytic converters on all of their 1975 cars, even on models where other methods of emissions control would meet the federal interim standards. Reasons given for this voluntary conversion include the improved mileage and decreased engine maintenance afforded by the catalytic converter system.)

Although the Clean Air Amendments as passed only allow for a one-year suspension, amendments included in the Energy Supply and Environmental Coordination Act of 1974 effectively suspended the stringent "90%" requirements for an additional year, until 1977 for HC and CO, and until 1978 for NO_x. In the same act, 1975 interim standards for HC and CO, and the 1975 statutory standard for NO_x were extended to apply also to model year 1976, while the 1977 NO_x standard was set at 2.0 grams/mile. In addition, provisions were made for possible one-year suspensions of the HC and CO standards until 1978, while the NO_x suspension option was dropped. The outcome of all these revisions as of late 1974 is indicated in Figure 1, which displays emission standards vs. time profiles for HC, CO, and NO_x.

These several revisions of automobile emissions standards illustrate the possible consequences of setting rigid deadlines and standards. If the technology develops more slowly than expected, repeated revision of those deadlines becomes necessary. While granting the possible stimulating effect such rigid deadlines may have on the development of the requisite technology, this must be traded off against the possible disrupting effects of the repeated revisions on the orderly evolution of the industry.

The changing of the automobile emission standards forms just one example of resetting deadlines in environmental laws. Another example is the suspension of powerplant emissions standards due to the energy crisis by the Energy Supply and Environmental Coordination Act of 1974. Other examples of potential suspensions can be cited in water quality, noise control, and other environmental laws.

The arguments for and against resetting the deadlines represent conflicts in the values and goals of our society. In the interest of environmental protection, each suspension or postponement would entail a greater environmental cost on the one hand, while lowering the level of social and economic disruption on the other. The reasons for resetting the deadlines usually fall in one or more of the following categories.

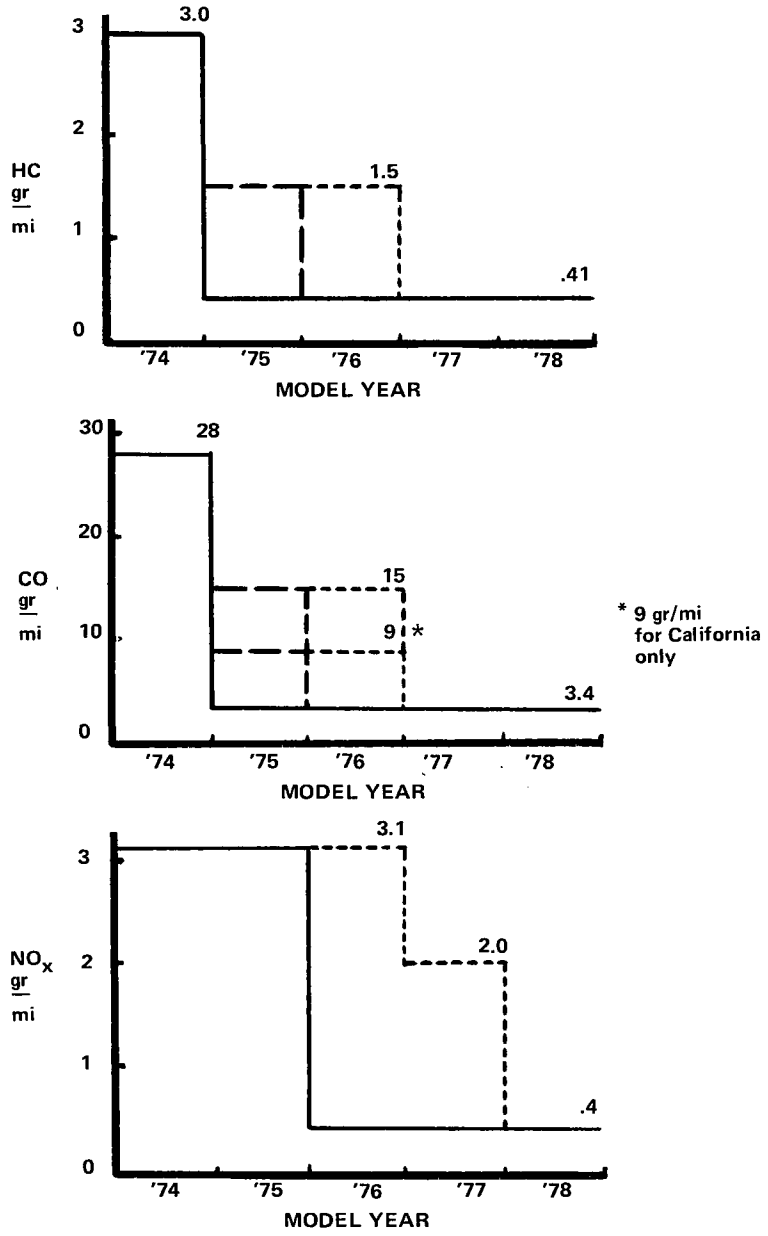

Figure 1. Federal vehicle emissions standards, with revisions.

1. The shifting of social values takes time—Americans are not going to abandon private automobiles in the foreseeable future, especially in the areas with no convenient substitutes. Thus, when EPA suggested strong measures to penalize the use of automobiles in Los Angeles as a way to comply with the ambient air quality standards, it was the standards which had to be changed or suspended.
2. Technological and institutional innovations take time—new automobile engines are a case in point. It is not sufficient to generate new concepts and to prove their technical feasibility, which are uncertain and time-consuming. Time must be allowed also for retooling, parts supply and distribution, and for coordination with supporting industries, as with the oil industry in the production of no-lead gasoline.
3. Environmental goals are superceded by higher-priority needs—To meet urgent energy demand, the ban on the use of high-sulfur coal in many fossil plants was suspended as the environmental goals were superceded by energy goals.
4. Second thoughts about tradeoffs—rational tradeoffs are seldom used as the basis for environmental legislation. Whatever tradeoffs are employed must be used without complete information, either about the actual consequences or about the preferences between alternative outcomes. The public generally has second thoughts about environmental laws and their enforcement when they begin to see more clearly, and experience more realistically, the consequences. These consequences may be economic, such as higher prices resulting from higher production costs, or worse balance of payments resulting from the need for more low-sulfur oil from overseas. They may be social, such as transitional or permanent unemployment resulting from work stoppage or closing down of industrial plants. They may even be environmental, such as the increased strip mining in the West resulting from the higher demand for low-sulfur coal.

Past Research

A number of studies have been made on the economics of clean air and of water quality control. A partial list of these studies is given in Appendix A. Perhaps the most significant recent report on this subject is the one submitted by the National Academy of Sciences (NAS) and the National Academy of Engineering (NAE) to the Senate Public Works Committee, "Air Quality and

Automobile Emission Control," published in September, 1974. This half-million dollar study produced quantitative estimates of the direct costs of meeting statutory emission standards embodied in the Clean Air Act and the direct benefits of clean air in the medical, biological and physical categories. The conclusions of the report are given in cost-benefit terms. For example, it estimates the annual cost of meeting automobile emission standards at $5 to $8 billion, and assesses the corresponding benefits of clean air at between $2.5 and $10 billion a year.

Several comments can be made on the NAS-NAE report. In the first place, the report made explicit the uncertainties in each cost and benefit estimate by giving a range in terms of upper and lower limits. This is necessary because of inadequate data, disparate opinions on the techniques used in their estimates, and the allowance of margin for error in quantifying the incommensurables. However, without a more explicit and precise description of the uncertainties in terms of probability distributions, it is difficult to draw logically clear conclusions. Secondly, in concentrating on annual direct costs and benefits, the report fails to adequately include the time dimension in its analysis. The study does not yield clear data on the important externalities or side effects of the regulatory deadlines necessary to achieve the change in air quality. These indirect effects, such as the transitional unemployment and technological shift discussed previously in this paper, give rise to transitional costs that would be especially important in comparing one emission standard vs. time profile (as in Figure 1) with another.

Presumably, by expanding the NAS-NAE study results to include indirect transitional cost and benefit estimates, one could use these figures and an appropriate time discount rate to make comparisons between one standard vs. time profile and another. Time discount analysis has been the traditional approach to both public and private investment analyses, where the tradeoffs must be made between present consumption and future return to investment [6]. However, while the basic concept of time discount is easily understood, it has proven fraught with both practical and theoretical difficulties [7]. In the first place, the choice of an appropriate social rate of time discount has been practically difficult and theoretically controversial. We will not review the polemic theories here, but suffice it to say that different social rates of discount, each supportable by a reasonable theory, could lead to opposite conclusions on public expenditure decisions.

More recently some serious studies have indicated the inadequacy of the time discount concept as applied to environmental problems.

The most basic problem lies in the consideration of irreversible losses. When nonrenewable resources are depleted, the cost involved is not only the acquisition cost, but also the cost of future opportunities foregone [8]. Although this concept seems to apply best to the depletion of mineral and fossil fuel stocks, several components of environmental degradation are irreversible, or reversible only at prohibitive cost. For example, prolonged degradation of water quality can lead to the extinction of species or the "killing" of a lake. These losses to society, in the form of opportunities permanently foregone in the future, are given relatively little emphasis in the time discount approach, due to the low importance the analysis assigns to future years. It is quite hard to imagine a time discount analysis that could adequately capture the essential aspects of the problem of irreversible loss.

In the light of the difficulties in applying the time discount concept, the more recent concepts of time preference in decision theory, especially of multiattribute utility theory, would be worthy of serious exploration for possible application. The basic idea here is to consider the time at which an outcome occurs as an additional attribute of the outcome. One may then apply the relatively established multiattribute utility theory to tradeoff one standard vs. time profile against another [9]. One major advantage of this approach over the time-discount approach is that it can capture the effects of the context of each future year. For instance, if a particular set of years in the future are predicted to have a relatively slack economy, and a choice among automobile emission standards will markedly affect the price demand curve for cars, then a multiattribute analysis over time could select the optimal standard vs. time profile, taking into account the interaction between the effects of the automobile emission standard and the state of the economy.

Significance of the Problem

The timing of environmental standards deadlines has become the central issue in environmental legislation debate. The major revisions of the Clean Air Amendments have all centered around the suspension of statutory standards, the postponing of deadlines. Standard vs. time profiles have become not only the center of debate, but also the basic guidelines around which industry and government agencies plan their research and development efforts, allocate their resources for purchasing and installing capital equipment, and make crucial decisions on plant locations and technological process selections. In other words, it is through the

instrument of environmental standards deadlines that legislative intent is translated into industrial and technological action. It would be hard to overestimate the importance of the timing of the standards. Revising the standard vs. time profiles could influence the expenditure of tens of billions of dollars, change an industry's basic strategy for research and development, cause operational transitions that could affect thousands of jobs, and precipitate the deaths of thousands of people.

Periodically, applications for suspension of environmental standards are accepted. Such events give rise to important hearings and congressional debate, forums for the interplay among many interest groups and social forces. Besides arguments in terms of dollars and number of deaths, some of the testimonies may refer to irreversible environmental damage that may result from further postponements, technical infeasibility of meeting environmental standard deadlines, and additional time required for proving or disproving scientifically the environmental impact on health of various technical measures (using tall stacks, etc.). In order to facilitate public understanding and intelligent debate, research as described in the following section is urgently needed.

Suggested Research

There are two component areas for suggested research related to the time dimension in environmental legislation. The first of these is to identify and measure the side effects of environmental standards and their deadlines, and the second is to develop methods for measuring social preferences over costs and benefits occurring in different years.

The side effects to be identified fall into two broad categories: indirect operating costs and benefits of the environmental standard, such as the balance of payments burden of importing low-sulfur oil; and transitional costs induced by the imposition of the deadline, such as transitional unemployment and economic disruption. The indirect operating costs and benefits are dependent upon the level of environmental standard. The transitional costs, on the other hand, are directly dependent upon the time allowed for transition to the new standard, and as such are the primary factors to be considered in setting the environmental deadline. To identify all the major side effects would require careful and imaginative analysis by an interdisciplinary research team. The methodologies of technology assessment would be quite valuable tools in that analysis [10]. The assigning of dollar values to these indirect costs and benefits would not be easy, but should not be any more

difficult than the dollar valuations made in the NAS-NAE study. In fact, for best utilization of the NAS-NAE report, the same valuation methodologies should be used wherever possible. This would make estimates from the different studies commensurate, and facilitate aggregation of total (direct and indirect) costs and benefits. Transitional costs should be measured as a function of the time left until the deadline. This function is most relevant to the time dimension in environmental legislation, since it provides measures of incremental benefits or costs of postponing or advancing environmental standards deadlines.

The costs and benefits of the side effects are not likely to be as large as the direct costs and benefits. However, when the direct costs and direct benefits are almost equal, the indirect costs and benefits could influence a major decision. Even if the calculus of cost-benefit analysis turns out to be insensitive to the side effects, the suggested research would still be useful by making the costs and benefits of side effects explicit, thereby increasing public understanding of any dispute over the side effects. Furthermore, the cost estimates of side effects could provide a rational basis for compensating the affected groups in society.

Questions concerning the time dimension in environmental legislation usually involve the comparison of benefits and costs occurring in different years. As discussed previously, it would be difficult to apply the time discount concept in this context. In addition to the problem of irreversible loss, it would be unconvincing, for example, to discount the value of future life and health at the same rate as the cost of capital equipment. A more flexible analysis would be to compare the consequences of different deadlines using a multiattribute utility analysis, including time (the year of each consequence) as one of the attributes. This analysis would call for the measurement of preference tradeoffs between benefits or costs occurring in different years. Factors affecting these tradeoffs include both the time remaining until the year of the consequence, and how that consequence fits into the economic and social context of that year. Although methods for measuring these tradeoffs have already been developed and employed in other applications, measures specific to the environmental legislation context need to be developed. This research would involve an extension of the existing body of multiattribute utility theory into a social preference situation.

Finally, the two component research efforts must be integrated into a comprehensive analysis of the overall benefits and costs of shifting environmental deadlines. This analysis would combine direct and indirect annual operating costs and benefits, as well as

transitional costs. If, for example, a one-year postponement in an environmental deadline were being considered, this analysis would compare the loss in benefits of the delayed increase in environmental quality, the decrease in pollution control costs, and the decreased transitional costs due to the longer transitional period, taking into account the relevant preference tradeoffs between benefits and costs occurring in the years involved.

There is little question that the research areas suggested above are worth pursuing, but how should one proceed? What should be done to maximize the chance of successful utilization of the research result? Obviously we do not want to pick an area of research such that the results come out after the critical decisions are made. An initial step must be taken to identify major environmental legislative debates related to environmental deadlines, which are scheduled far enough in advance to make research results usable. It will be desirable to involve the critical decision makers and their staffs in problem formulation, briefings of preliminary research results, and discussion of final conclusions. Inputs from all major affected interest groups should be included in the research. The continual involvement of the research team with decision makers and affected parties will not be an easy task. Needless to say, this research must be funded in such a way that the research team can maintain sufficient independence from undue influence.

It should be made clear that the goal of the proposed research is *not* to encroach on the political decision maker's domain, or to directly specify the optimal solution. The governing process in a democracy is always one of compromise between conflicting interests, and we recognize that the political process is of course the only legitimate way to reach a final decision. The ultimate intent of the proposed research is to help create an information base that is as comprehensive as possible, and to provide a means of organizing that information into a framework that will promote more rational, constructive, and well-informed political debate.

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APPENDIX A

A Partial List of Economic Studies of Environmental Laws

1. "Air Quality and Automobile Emission Control," A report by the Coordinating Committee on Air Quality Studies, National Academy of Sciences and National Academy of Engineering, prepared for the Committee on Public Works, U.S. Senate, serial no. 93-24, September, 1974.
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5. "The Economic Impacts of Meeting Exhaust Emission Standards 1971-1980," Chase Econometric Association, Inc., NTIS #PB-207-202, December, 1971.
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