ECONOMICS IN EPA

A Report

by

The Subcommittee on Economic Analysis
Science Advisory Board
U.S. Environmental Protection Agency

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* Dr. Leontief has abstained from accepting the conclusions and recommendations of this report. His reasons are detailed in Appendix A.

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I. THE ROLES OF ECONOMICS IN ENVIRONMENTAL POLICY

A. Introduction

Economics has a vital role to play in the formulation and implementation of environmental policy. It can greatly assist EPA in making the numerous choices it faces. Economics can also make important contributions to the Agency's relations with outside political forces such as Congress, the courts, and the public.

One of EPA's essential continuing tasks is planning its program so that the most urgent environmental problems receive prompt attention. Economics has an important role to play in program planning and in assigning priorities. These decisions require preliminary assessments of the social costs of a wide variety of environmental threats and impairments. For example, it may be necessary to compare the social costs inflicted by a number of industrial effluents, some of which endanger health, some of which defile recreational areas, and some of which interfere with neighboring economic activities. The physical and physiological effects of the effluents can be assessed by natural scientists and engineers; comparing the values society places on such effects is essentially an economic task.

What actions should be taken in specific cases should be based, in part, on economic analysis. The evaluation and comparison of the costs and benefits of any contemplated action not only provide essential information for making the decision but also provide an overall framework for structuring information so that it can be useful to the decisionmaker. (Unless otherwise noted, this report uses the term "benefits" to refer to all of the gains from an action and "costs" to refer to all of the losses. The terms are not confined to financial or monetary gains or losses.) Because economics seeks to explain the behavior of firms and other organizations, it can help to predict the responses of firms to alternative forms of regulation. The implementation and structure of regulatory decisions can be improved by economic approaches which may suggest more effective and efficient methods for accomplishing environmental goals.

In the past, when the economic impacts of environmental programs were smaller and the competing pressures created by the energy problem and inflation were less pressing, there was less demand for EPA to consider economic factors. In the present context, however, economic considerations are an inescapable element of every important decision made by the Agency. EPA must justify the costs it imposes on the public; it must economize on those costs; and it must avoid actions whose costs it cannot justify in the eyes of the public. For all of those ends, economic analysis is essential.

Actions taken by EPA are subject to many constraints imposed by forces outside the Agency. For example, the courts require EPA to show that its regulations are reasonable. Under some statutory provisions EPA has to demonstrate that, before issuing a regulation, it has made a well-informed and competent evaluation of both the costs and the benefits of the regulation and that a reasonable man could conclude that the benefits are commensurate with the costs. Thus, economic analysis is necessary to sustain the legality of EPA decisions.

EPA's effectiveness, like that of any other agency, depends upon a constituency which believes that EPA's program is worthwhile and depends upon willingness to comply with the Agency's regulations. Without such support, the Agency's enforcement problems will become intractable, and the entire program will be subjected to erosion as a result of the pressures of special interest groups and the demands of competing social objectives. Maintenance of such support, especially among business groups and the general public, requires careful consideration of the costs and benefits of Agency actions and programs, including how such costs and benefits are distributed among segments of the population and how EPA's activities impact other social goals. In short, careful and sophisticated economic analysis is required.

As will be discussed later in this report, there are major limitations on the ability of economics to provide the kinds of analyses needed for EPA programs. Some of these limitations are due to the current state-of-the-art of economics; others are due to the inadequacy of the data available or the incompleteness of scientific knowledge. The major initial step needed to overcome these limitations is a recognition within the Agency of the role that economics should play. If the need for economic analysis is recognized, then the steps to fulfill the need are more likely to follow.

The role of economic analysis can be seen in more detail by examining it in the context of types of EPA decisions. Later in this report we will examine separately the analysis of costs and the analysis of benefits.

B. Costs and Benefits of Regulations

EPA perceives that its central function is to issue regulations. The Agency collects a lot of information and does extensive research, but these functions are aimed at supporting the regulatory process.

Intelligent decisons about regulations require economic analysis of the costs that the regulations will impose on society. Without such analysis, the decisionmaker will not know whether the costs of a specific regulation will outweigh its benefits or whether some alternative regulation might accomplish the same

purpose at a lower total cost. With such analysis he or she will be in a better position to predict the political reaction to the regulation; then it is likely that the regulation will be successfully implemented.

A few statutory mandates administered by EPA ostensibly require the Agency to look at only the health benefits when considering regulations. But, in almost every case, such a requirement is unrealistic. For example, in setting primary air quality standards, it has become increasingly clear that to protect the more sensitive members of the population EPA would have to set the standards at zero, i.e., prohibit any pollution whatsoever. EPA has not done so, and Congress has acquiesced in the Agency's failure to do so because the costs of standards set at zero would be unacceptably high.

Economics can also contribute to evaluation of the benefits of a proposed regulation. Many kinds of benefits, such as savings in hospital costs, reduced damage to crops, and incresed property values, deal with things that are traded in the marketplace, can be readily analyzed using economic methods, and can be meaningfully expressed in dollar terms. The values of goods that are not traded in markets can sometimes also be expressed in dollars using a variety of methods. The advantage of expressing the benefits as well as the costs in dollars is that it allows a direct comparison between the costs and the benefits. This is important because the relationship between the costs and benefits is at least as important as the absolute value of either one. Furthermore, direct comparisons of costs and benefits promote consistency among regulations and also may indicate more efficient ways of achieving a regulatory goal.

It is not suggested here that health and safety regulatory decisions should be made on the basis of a formal cost-benefit analysis. There are too many uncertainties and too many limitations on cost-benefit analysis for EPA to rely on it as the sole basis for making decisions. But a thorough accounting and analysis of all available information on both costs and benefits is necessary to ensure that regulatory decisions contribute to the national welfare.

C. Costs and Benefits of Programs

Economics can also provide the methods for analyzing the costs and benefits of entire programs, such as the solid waste program; the municipal waste treatment grant program; the automobile emissions control program; and, indeed, EPA's entire effort to protect the environment.

Program analyses serve two functions. The first is political or informational. People other than economists ask questions such as "Is the program worthwhile?" or "Are the benefits of the program really worthwhile?" In fact, an increasing number of Congressmen,

businessmen, and citizens are asking just such questions about environmental programs. They are entitled to answers, and the EPA programs will be gravely jeopardized if those answers are not forthcoming.

The second function of program analyses is to identify programs that are high-priority candidates for improved regulatory approaches or, in the extreme case, those that should be eliminated. For example, a number of analyses of the automobile air pollution control program indicate that alternative approaches, such as requiring emission control devices on cars registered in urban areas different from those for cars in rural areas, are seriously worth considering.

D. Economic Impacts

An examination of the overall economic impact of EPA's programs is necessary to anticipate obstacles to compliance with the programs, to identify and examine conflicts between environmental policies and other national goals, and to evaluate the full costs and benefits of Agency programs.

Economic impacts can be examined at both the micro- and macroeconomic levels. At the microeconomic level EPA has begun to examine the impact of all Agency programs combined on particular industries. By using such studies, the Agency can determine how much of a strain environmental requirements impose on an industry, locality, or segment of the population and can thus detect situations in which its regulations are causing hardship. In this spirit, for a number of years EPA has kept track of plant closings attributable to environmental regulations, so that remedial measures can be taken for unemployed workers. Data on plant closings also serve as a politically relevant indicator of the economic impact of Agency programs.

On the macroeconomic level, studies have been conducted on the impact of EPA programs on inflation, employment, economic growth, productivity, income distribution, and technological innovation. Such studies are needed to show the present and future effects of environmental programs on the national economy and to show areas where environmental and economic goals may be in conflict. If accomplishing environmental goals diverges too greatly from the accomplishment of economic goals, the environmental programs are likely to be curbed or altered.

E. Alternative Regulatory Strategies

Large portions of our lives are controlled by market mechanisms, and it is one of the functions of economics to understand these mechanisms and explore their applications. Many environmental regulatory programs could potentially employ market mechanisms to supplement or replace the more traditional

"command-and-control" approach. There is good reason to believe that in some cases market incentives might be both less costly and more effective than the regulatory approach.

Economics can also be used to decide among alternative regulatory strategies through the use of cost-effectiveness analysis. Given a goal to be attained (such as a specific environmental standard), such analysis can examine the best method of achieving that goal. Economic analysis can help Agency officials choose among different control mechanisms or different regulations.

Stragegic choices about program priorities can also be made using economic analysis. One way of looking at priorities is that those decisions that will produce the most benefits for any given cost should have the highest priority. Using this benefit-cost framework obviously involves economics.

F. Organizing Information

One of the valuable roles that economists can perform is to provide a framework for integrating different research efforts and linking these efforts with decisionmaking. An integrated system of models and data bases that promotes the assemblage and analysis of data in a systematic manner could provide EPA with a badly needed capability to assess the environmental situation and to anticipate changes to be brought about by future economic growth and new technology. Economic modeling approaches--for example input-output analysis, regional models, microdata simulation, and general equilibrium models--can provide the framework for such a capability.

Some of the important advantages of integrating models are that they 1) provide a data depository designed to be used and not just to provide dead storage; 2) automatically provide a way to link the various data sets; 3) force a measure of quality control and consistency on the data collection effort; 4) enable the economic impacts of a decision to be traced through the economy to reach a more comprehensive evaluation of its impacts; and 5) allow the data to be analyzed from many different perspectives. For an agency such as EPA, which deals with huge amounts of data and complex interrelationships among natural, technological, and economic factors, these functions are of great importance.

We shall next turn to an examination of the economic analyses which EPA has actually conducted.

II. ECONOMIC ANALYSIS DONE BY EPA

A. Statutory Authority

A brief glance at the core of the EPA's regulatory authority to deal with health, safety, and environmental problems reveals that the following acts, in one or more of their sections, currently permit or require some form of economic analysis: The Toxic Substances Control Act, 15 U.S.C., S.S. 2601 et. seq., The Clean Air Act, 42 U.S.C., S.S. 1867, et. seq., The Water Pollution Control Act, 33 U.S.C., S.S. 251 et. seq., The Safe Drinking Water Act, 42 U.S.C., S.S. 300f et. seq., and The Federal Insecticide Fungicide and Rodenticide Act, 7 U.S.C., S.S. 136 et. seq. In addition to the acts, Executive Order 12044 (March 23, 1978) requires economic analyses of major decisions.

B. Economic Focus

A review of the Agency's organization chart provides a perspective on the role of economic analysis within this statutory framework. The most concentrated economic focus is in the Office of Planning and Management (OPM), Office of Planning and Evaluation (OPE), which has an Economic Analysis Division consisting of three branches: Industrial Analysis; Air Economics and Special Projects; and Water Economics. The Economic Analysis Division of OPE provides EPA with a means of monitoring the overall impact of the Agency's programs on the economy and tries to insure that all proposed regulations make economic sense.

The Office of Water and Waste Management has a Water Economics Division under the Office of Analysis and Evaluation to conduct its economic analyses. The Office of Air, Noise and Radiation Programs has economic divisions under the Office of Radiation (Economics & Statistical Evaluation Branch), Air Quality Planning & Standards (Economic Analysis Office), and Mobile Source Air Pollution Control (Program Management Office) to conduct its economic analyses. The Office of Research and Development has responsibility for methods development and analysis of the benefits of environmental improvement, except for the benefits of specific regulations. The Office of Toxic Substancs has economic divisions under the Office of Chemical Control (Office of Regulatory Analysis) and the Office of Pesticide Programs (Economic Analysis Branch) to conduct its economic analyses. Although the Office of Enforcement lists no specific economics office, the Agency has produced at least three reports dealing with enforcement economics.

Currently, the activities of the Agency in terms of economic analysis may be grouped into the following categories: 1) macro-economic analysis, 2) program specific analysis, 3) regulation specific analysis, 4) industry analysis, 5) issue analysis, 6) plant closures, 7) special reports, and 8) methods development.

1) Macroeconomic analysis, done for OPE mainly by outside contractors using econometric models, is designed to assess the overall impact of pollution control costs on the U.S. economy.

2) Program specific analysis, done primarily by the various program offices or their contractors, is an attempt to assess the impact of a particular pollution control program (e.g., Water and Hazardous Materials) on the economy.

3) Regulation specific analysis, done primarily by the various program offices or their contractors, is an attempt to assess the economic impacts of specific regulations. OPE provides direction to the program offices concerning these studies and a review of their work. The is currently the bulk of EPA's economic activities since, for many regulations, a formal economic impact assessment is required by law, while for others the analysis is required by Executive Order 12044. And, generally, even when economic impact analysis is not required, the Agency conducts one to inform itself of the economic consequences of its activities.

4) Industry analysis is conducted by OPE since most industries are affected by more than one set of environmental regulations. In some cases, the costs of the combined set of regulations are much greater than would be included in the economic impact analysis of the individual regulations. In other cases the combined impact may be less than the sum of the costs of individual regulations, for example, if a single process change can be used to reduce both air and water emissions. An analysis of overall industry impact has been completed for the petroleum industry, and one is currently underway for the chemical industry.

5) Issue-specific analysis is an economic assessment of special issues which may arise; this is done primarily by OPE. Examples of issue-specific analyses are analyses of the impact of EPA's programs on jobs or the development of a mechanism to assess fees to remove the economic advantages of noncompliance with environmental regulations.

6) Plant closures due to the costs of environmental regulation are a very sensitive issue and have prompted EPA to develop an early warning system. Every quarter, based upon a review of the early warning system, OPE sends a comprehensive information report to the U.S. Secretary of Labor detailing possible unemployment problems in affected areas. To date, only twenty plants, fifteen percent of the total 136 which have

been reviewed, have actually closed due to environmental regulations. In many cases, OPE also investigates whether measures can be taken to allow plants to stay open.

7) Special reports of a type similar to those conducted under the heading of issue analysis, i.e., "Cost of Clean..." reports, are also done by EPA through the Office of Planning and Evaluation.

8) Methods development is the broad area of general responsibility that belongs to the Office of Research and Development's (ORD) Economic Analysis Division. Much of this work is done by contract with some of it being done at the various laboratories, where the physical data are gathered and analyzed. Currently, ORD is involved in a major program to improve the methodology for determining the benefits of national and regional pollution programs and to make initial applications of such methodologies.

Within these eight areas of analytic activity EPA conducts cost, benefits, cost effectiveness, and benefit-cost analyses (Table 1). The cost analyses and the benefits analyses form the foundation of all of these studies.

Cost analysis or cost-impact analysis may be defined as the estimation of all of the costs--direct, indirect, capital, maintenance and operating--that result from an actual or a proposed regulation or program. As Table 1 shows, the largest number of cost analyses deal with the costs entailed by specific regulations. These studies typically take the form of engineering cost estimates of the capital equipment and the cost of operating procedures required by the regulation. For regulations that affect agriculture, however, the reduction in the size of the crop likely to result from the increase in costs of production is often taken into account. The result of the analysis may be expressed as either an average annual cost or as the present value of the costs incurred over some substantial period of years, and as either aggregate costs imposed on the industry or as costs per unit of output. In principle, indirect costs and nonmonetary costs are included in the concept, but they are generally neglected in practice except in the case of "plant closings," as mentioned above.

Benefits analysis is the other side of the coin. It consists of estimating the beneficial effects of a protective program or measure. A determined effort is made to estimate the beneficial effects of a program or regulation quantitatively. A bewildering variety of units results: reductions of discharges in kilograms per year or per $1,000 worth of output; reductions in ambient concentrations in grams per liter; reductions in the incidence of respiratory infections in cases per 100,000 population; reductions in medical expenses in dollars per year; etc. Note that as one

moves from the relatively straightforward reductions in pollution loads to the monetary values of induced changes, the concepts become simultaneously more meaningful for administrative decisionmaking and more complex and difficult to estimate. All levels of benefits estimation are difficult. For this reason, largely, the sample reported in Table 1 included far fewer benefits analyses than it did cost analyses.

Benefits analysis can be divided into four tasks or levels, not all of which are carried out or even attempted in every study. The least difficult level or task of benefits analysis is the estimation of the immediate effects of a protective measure, most frequently a reduction in the volume of pollutants discharged into the environment. There are a number of reasons why this task is not simply a matter of engineering estimation. For example, pollution abatement equipment rarely operates at one hundred percent of rated efficiency; municipal waste treatment plants and automotive emission control devices are well known instances. Careful analysis of the actual conditions of use and sound judgment are, therefore, required to make a reasonable estimate of the reduction of pollution loads that regulations are likely to cause. The second level or task is to estimate the effect of the reduction in pollution loads on ambient conditions, usually pollutant concentrations in environmental media. This is generally a tricky undertaking because pollutant concentrations are very sensitive to a number of uncontrollable and very variable circumstances. Concentrations in water depend upon stream flow, tidal conditions, wind, and temperature, all of which vary substantially diurnally and seasonally and are often unpredictable. The effects of reduced emissions on atmospheric concentrations are even harder to estimate, because concentrations are sensitive to wind strength and direction, the peculiarities of the microclimate, the complexities of atmospheric chemistry, and much more. Often very crude methods of estimation are used, such as "linear rollback models," which rest on the assumption that ambient concentrations are linearly and, indeed, proportionally related to changes in emissions. The third level or task is still more difficult: it is the task of translating estimated reductions in ambient concentrations into socially significant consequences. By far the most significant of all consequences, in most instances, are effects on public health. This translation is obstructed by two major obstacles. First, it requires estimates of human exposure, and these, in turn, depend upon predictions of human behavior patterns about which little is known. Second, the effect of environmental pollutants on health depends upon dose-response relationships that are poorly understood for most pollutants, in spite of a great deal of study and research. The fourth level of a benefits analysis, and the one most frequently omitted, is a conversion of the physical changes--changes in discharges, ambient conditions, disease incidence, or whatever--into evaluative units that express their social importance, almost invariably in monetary units. A vast amount of theoretical and empirical research has been devoted to the problem of ascertaining the monetary values equivalent to environmental changes, for which there are no market

prices. To the extent that environmental changes affect the cost of producing marketable commodities, there are satisfactory and well established methods for estimating their social and economic importance. But to the extent that environmental changes impinge directly on public welfare, the task of evaluation is still problematic.

This list of the difficulties that beset benefits analysis accounts for the comparative paucity of benefits studies in Table 1. Even the studies that have been made, in general, stop well short of completing all of the tasks that a complete analysis requires.

Cost-effectiveness analysis is a procedure for evaluating regulations or programs by straightforward comparison of the cost with the degree of attainment of one of the types of benefits. Typically, a simple ratio is computed, and the result is expressed as either units of benefit per dollar of cost or as units of benefit per year per dollar of cost per year. For example, the results of a cost-effectiveness comparison might be reduction in average lifetime intake of pollutant (in grams) per dollar of annual cost. Clearly, this mode of comparison is most appropriate for programs that have only a single kind of benefit or for which one type of benefit is of preponderant importance. It can be misleading; when a number of alternative programs are being compared, the one with the highest cost-effectiveness ratio is not necessarily the most effective. The reason is that the alternative with the highest cost-effectiveness ratio might achieve an unduly low absolute level of benefits. Referring to the last example, the alternative with the largest reduction in lifetime intake per dollar expended might still reduce that intake only to a level that still is judged to be unsafe. Despite these shortcomings, cost-effectiveness analysis has much to recommend it because of its simplicity. It permits straightforward comparisons among alternatives that achieve adequate levels of benefit, and it is often applicable in many cases where the benefits analysis has had to be truncated before completing the final stage.

Benefit-cost analysis is a family of procedures for making more inclusive and ambitious evaluations of regulations or abatement programs. Its simplest version applies in situations where all of the benefits can be expressed in monetary units. Then the excess of the discounted present value of the benefits over the present value of the costs measures the net social value of the regulation (or program) under study. Alternatively, the comparison can be made by subtracting the average annual cost from the average annual benefit. The program is acceptable only if the net social value is positive, and then only if the level of benefits (in physical rather than monetary units) is deemed adequate.

More often than not, however, there will be some kinds of benefits that do not have satisfactory monetary equivalents. Then, the benefit-cost analysis takes the form of graphic and tabular displays designed to show the results of the alternatives under study and to facilitate appreciation of the trade-offs among them.

C. Review of Economic Analysis to Date*

Table 1 reviews 427 economic analyses which have been done by or for the U.S. EPA from January 1970 through June 1979. The table was constructed from a review of abstracts of the various studies and by checking the characteristics of the study in the appropriate categories. For example, a single study might be classified as regulation specific and industry specific, as well as needing both a cost and a cost-effectiveness analysis. One can see, by looking at this table, that most of the Agency's analyses to date have been industry specific, regulation specific, or plant closure studies with the major focus on the cost of regulation. This has been confirmed to the Science Advisory Board's Economic Analysis Subcommittee by presentations from Agency economists. However, the Agency has recognized the value of benefits analysis and is putting more emphasis in this area. EPA's Fiscal Year 1981 budget includes approximately $4.5 million for analysis of the benefits of environmental programs.

Table 2 considers the various program offices and whether the types of analyses conducted by or for them were cost, cost-effectiveness, benefit-cost analyses, or benefits analyses. This table shows that most of the Agency's effort has been in the area of cost analysis and that OPE has played a major role in conducting, or at least reviewing, these studies. Similarly, we see that most of the benefit-cost analyses and benefits studies have been done by ORD with primary responsibility for methods development. In addition, this table shows that to date the air and water program offices have been major performers and users of economic analysis. One would expect the Office of Toxic Substances to become a more active user as it begins to implement the Toxic Substances Control Act.

Table 3 examines, in greater detail, the four categories of economic analysis that have been done at the industry specific level and compares the number of studies dealing with each industrial sector with the actual reported capital expenditures committed by that sector to comply with environmental regulations. The percentage distribution of the studies identified generally closely parallels the percentage distribution of expenditures by industry, indicating that the Agency has been allocating its analytic resources in accurate proportion to the economic costs of its regulatory activities.

Table 4 is a matrix which examines the 48 benefits analyses which had been done through June 1979 in terms of the damage costs considered and the various media programs to which they relate. As the Agency comes under increasing scrutiny concerning the costs of

* The tables in part C are based upon an analysis of EPA data by the Executive Secretary of the Subcommittee.

environmental regulations and is faced with the need to allocate its budget among the various program offices, this type of study will increase in importance.

Section III of this report presents some observations and examination of EPA's analyses of benefits and costs.

TABLE 1

Types of U.S. Environmental Protection Agency Economic Studies from January 1970 through June 1979

	Cost	Cost Effectiveness	Benefit-Cost	Benefits
Macroeconomics (all acts)	9	1	-	2
Program Specific (a number of related acts)	26	5	3	26
Regulation Specific (section of an act)	133	3	12	11
Industry Specific (impact of a regulation)	116	47	11	-
Methods Development	15	4	5	11
Plant Closures	137	34	-	-
Issues (special reports) (economic incentives) (etc.)	29	4	4	5

Total number of studies is 427. Column totals may be greater because some studies included more than one category.

TABLE 2

Economic Studies by Program Office in the Environmental Protection Agency from January 1970 through June 1979

	Air & Hazardous Waste	Water	Solid Waste	Noise	Radiation	Toxic Substances	Research & Development	Planning & Management	Enforcem
Cost	108	61	11	14	5	22	54	358	3
Cost Effectiveness	3	6	-	-	-	1	7	45	-
Benefit-Cost	1	3	-	-	1	2	17	7	-
Benefits	18	10	1	1	-	1	40	12	-

Total number of studies is 427. Column totals may be greater because some studies included more than one category. Benefits include earlier studies identified as harm or damage costs from pollution.

TABLE 3

Review of Industry Specific Economic Studies of U.S. Environmental Protection Agency from January 1970 through June 1978 Compared with New Plant and Equipment Expenditures for Pollution Abatement from 1973 to 1977

	1	2	3	4	5	6	7	
	Cost	Cost Effective	Benefit-Cost	Benefit	Total Number of Studies	Percent of Total Studies	Expenditures for Pollution Abatement***	Percent of Total Expenditur
All Industry	116	47	11	-	174	100	31,105	100
Manufacturing	83	37	10	-	130	75	20,106	65
Durable Goods	31	14	-	-	45	26	8,297	27
Primary Metals	20	4	-	-	24	14	4,490	14
All Others*	11	10	-	-	21	12	3,207	10
Non Durable Goods	53	22	10	-	85	49	11,765	38
Food, Textiles, Paper	6	8	-	-	14	8	3,268	11
Chemicals, Petroleum	44	15	10	-	69	40	8,351	27
All Other Non Durable	2	-	-	-	2	1	136	1
Non-manufacturing	33	10	1	-	44	25	11,000	35
Mining	11	2	-	-	13	7	414	1
Public Utilities	8	7	1	-	16	9	9,197	30
All Others**	14	1	-	-	15	9	1,401	5

* Includes machinery, transportation equipment, stone, clay, glass, etc.

** Includes transportation, communication, commericial, etc.

*** New plant and equipment expenditures, unit measured in $ x 10^6, taken from Rutledge, G.L., F.J. Dreiling, and B.C. Dunlap, "Capital Expenditures by Business for Pollution Abatement 1973-77 and Planned 1978" Survey of Current Business, June 1978, as cited in The Status of Environmental Economics: An Update, a report by the Congressional Research Service for the Committee on Environment and Public Works, U.S. Senate, Serial No. 96-6, July 1979, pp. 152-153.

TABLE 4

Media Matrix of Economic Benefit Studies by the U.S. Environmental Protection Agency from January 1970 through June 1979

Benefits	Air and Hazardous Wastes	Water	Solid Waste	Noise	Toxic Substances
Human Health	10	10	1	1	1
Animal Health	1	6	-	-	1
Vegetation	11	3	-	-	1
Real Property	7	9	-	1	-
Maintenance and Materials	8	4	-	-	-
Recreation	2	10	-	-	-
Aesthetic	9	5	-	1	1
Miscellaneous	8	5	-	-	1
Avoidance Costs	7	5	-	1	-

Total number of studies is 48. Column totals may be greater because some studies included more than one category. Benefits includes earlier studies identified as harm or damage costs from pollution. There were no benefits studies identified for the offices of Enforcement or Radiation.

III. IMPROVING THE ANALYSIS OF BENEFITS AND COSTS

A. Analysis of Benefits

The ultimate objective of environmental regulation is to improve social welfare by making the best use of society's resources, including environmental resources. This necessarily entails an effort to identify and quantify beneficial and costly effects of proposed regulations. This section examines two major areas of EPA's regulatory responsibility so as to identify opportunities to use economic analysis in the measurement of beneficial effects and, in each case, to assess the state-of-the-art and to identify needs for theoretical and methodological development and better data.

The estimation of benefits of regulatory proposals, which can be compared with costs, requires the identification and quantification of beneficial effects such as reductions in morbidity and mortality expected to result from proposed regulations. This task is difficult because of the frequent lack of firm knowledge of dose-response functions and other relationships between environmental conditions and effects. In these cases, the estimation of benefits will require basic research into the quantitative relationships between levels of pollutants and exposures, on the one hand, and beneficial uses of the environment such as for recreation, health, crop production, and so forth, on the other hand. The task is also complicated by the fact that it is usually difficult to relate changes in ambient conditions to specific regulations.

If monetary values are to be assigned to the benefits, the economic theory of value is fairly well developed for those environmental effects which impinge directly on people. However, empirical implementation of this theoretical framework is, in many instances, fraught with difficulties such as absence of necessary data. Also, the theory of value is not well developed for such non-user "benefits" as species diversity and stability.

Some of these problems are evident if we examine EPA's analysis of the benefits of air pollution control. To estimate the benefits to human health of air pollution control, we need improved physical models that can separate nonpolicy effects (such as the general level of economic activity) on pollution levels from the effects of regulations. We also must obtain better information on the dose-response functions for various pollutants, both singly and in various combinations. The major difficulty in obtaining better estimates of dose-response functions through human epidemiological studies is poor data on the actual exposures of members of the populations at risk. There are also problems in controlling for other factors contributing to mortality and morbidity, especially dietary factors, smoking, and exposures to environmental contaminants from other sources such as food, drinking water, and the workplace. EPA's Office of Research and Development is supporting basic research on health effects of air pollutants.

Better information on quantitative aspects of health effects due to air pollution would be very useful whether or not one took the further step of assigning monetary values to changes in morbidity and mortality. The assignment of monetary values to health effects, especially to mortality effects, is a controversial issue. There is a basis in economic theory for assigning values to small reductions in the probability of dying within certain time periods. However, efforts at empirical measurement of this willingness to pay using data sources, such as wage differentials across occupations with different risks of death, have yielded widely varying results.

The greatest potential for damage to vegetation comes from exposure to photochemical oxidants and to acid rainfall. The former is important for the possible revision of national secondary air quality standards for photochemical oxidants and as a basis for establishing emissions limits for automobiles. The latter is important in determining an appropriate policy for the control of emissions of sulfate and nitrate compounds. To estimate the benefits of possible changes in the national secondary air quality standard for ozone, EPA will have to obtain better information on the effects of low level exposures to ozone (in the range of .05 to .13 ppm) on crop yields and then combine this with data on ambient concentrations and cropping patterns to estimate crop losses on a regional and/or national basis.

The effects of acid rain may be more subtle and more far-reaching. If acid rain reduces soil pH levels, the effects on agricultural and forest productivity could be significant. In addition, acid rain is apparently affecting aquatic ecological systems.

In reassessing national secondary ambient air quality standards, the reduction of soiling, cleaning, and materials damages may be important but is likely to be substantially less significant in economic terms than the effects of air pollution control on human health. The major data needs are for better information on household and commerical cleaning behavior at different pollution levels and on the inventories of various types of materials exposed to different ambient pollution levels. It is necessary to incorporate models of economic behavior and choice in the analysis of the data.

There is a well developed methodology for utilizing information on property value differences within an urban area to estimate benefits of improved air quality. The major problem in utilizing property value study data to compute benefits for regulatory decisionmaking is the difficulty in separating the effects of different air pollutants because of collinearity in the pollution data. Also, it is difficult to know what categories of benefits are captured by property value benefits data. They are likely to reflect aesthetics, soiling costs, and damages to materials and ornamental vegetation. But do they also reflect impacts on human health?

Benefits due to improved visibility at the place of residence are likely to be incorporated in property values. Recently, regulatory attention has been increasingly focused on gaining improvements in visibility in rural areas, especially in Class I areas, as required by the Clean Air Act Amendments of 1977. At present, there is little information to support benefit estimates in rural areas.

Recreation benefits are primarily important in the analysis of water pollution control programs. Although present law establishes the objective of achieving "fishable and swimmable" waters, very little is known about the levels of water quality which are necessary to support these recreational activities or the benefits of achieving these pollution control objectives. Information is required to enable the prediction of changes in recreation activities as a function of changes in various parameters of water quality. Very little is known about which parameters of water quality are most important in influencing recreation behavior. There is a substantial number of studies providing information on the willingness to pay for and unit values of days of recreation activity at particular sites. However, unit values are known to vary with water quality, other attributes of the site, its accessibility, and the range of substitute sites available to the recreationist. More research must be conducted on the role of water quality in influencing willingness to pay and on value before this data base can be utilized easily in the estimation of recreation benefits.

The main point to emerge from the preceding discussion is that precise measurement of monetary benefits is not feasible, in most cases, with the existing data bases. Benefits estimation will require further basic research to improve our knowledge of such things as dose-response functions for health effects and behavioral responses to changes in pollution levels. Yet, given the increasing concern that regulation has gone too far in such areas as consumer product safety, occupational safety and health, and environmental regulation, it would be extremely useful to have estimates of the magnitude of benefits actually realized from existing environmental regulations. Also, improved knowledge of dose-response and behavioral relationships would make it possible to consider the beneficial effects of changes in regulations.

B. Analysis of Costs

Sound decisionmaking requires knowledge of how much things cost. Crude and superficial estimates are not reliable enough when important sums and important issues are at stake. EPA needs economically sound cost estimates to make economically and socially sound decisions.

Most of the EPA's primary research on the costs of environmental policy is undertaken in support of the promulgation of regulations. Because of this focus and the fact that the cost

estimates have to be prepared in a fairly short period of time, the level of sophistication of these analyses often may not satisfy professional economists.

Generally the studies implicitly assume that criticism of the estimates will come only from the industry being regulated. Therefore, the cost estimates tend to refer to short-run, private (not social) costs under conditions of fixed demand, because these types of costs are of most concern to the regulated industry. Since each regulation affects only one industry classification, what is ignored is the fact that a particular industry's cost may be offset by another industry's benefit and, therefore, given the unemployment of inefficiently employed resources, may not represent a true social cost. Since consumer groups (and economists) rarely, if ever, challenge promulgated regulations, there is not much incentive to employ a broader concept of social, as opposed to private, costs. If, as often is the case, control costs represent a small share of total industry costs of production, sophisticated analyses of long-run effects that allow for demand feebacks are unnecessary. For this reason there is usually only a qualitative assessment of market response, resulting plant closures, and reductions in output. Finally, it simply is not worth undertaking sophisticated analyses for those industries where challenges to the regulations are not likely.

While these costs analyses are generally sufficient for their primary purpose, it may be in EPA's interest to undertake more thorough analyses for several reasons. In the first place, the cost estimates drawn from these studies are widely used (Some would say misused.) for purposes other than to support the promulgation of particular regulations. In particular, these cost estimates are the basis of EPA and CEQ estimates of the costs of the entire environmental program; they have been used as inputs to large macroeconomic models to assess economy-wide impacts of regulations; and they have been used as inputs into certain of the industry-effects models.

Generally, these studies require cost concepts other than the simple, short-run, fixed demand concepts characteristic of the unsophisticated estimates. For example, the macroeconomic models require total expenditure estimates phased over time. The sophisticated industry-effects models require, for consistency, long-run cost estimates that reflect new output-price equilibria. Even if the EPA cost data were highly accurate measures of short-run costs, short-run costs are poor proxies for these other cost concepts.

Since EPA is both a consumer and a producer of those economic studies that have heavily relied upon EPA cost data, EPA should have an interest in assuring that their own cost data will not be misused. One way to assure this is for EPA itself to take the lead in expanding their costing efforts to generate data covering the wide range of cost concepts.

However, there is another reason for EPA to undertake an expanded, more sophisticated costing effort: namely, to upgrade the quality of the intended short-run cost estimates. While the cost estimates tend to reflect short-run conditions with fixed demands, the fact is that the definitions and assumptions underlying particular estimates are by no means clear. Presumably the discipline required for a better costing procedure would force more clarity with respect to definitions and assumptions.

At present, the concept of what is meant by control cost can differ estimate-by-estimate. For example, certain EPA contractors have attempted to estimate the incremental cost of federal pollution control policies; pollution control costs engendered by state and local laws or simply due to voluntary corporate efforts are excluded. Other contractors, in spite of clear guidelines to the contrary, have not made the same adjustment.

Still others have defined costs as the sum of expenditures to be incurred after some specified base year to comply with the regulation. If the base year coincides with the year of promulgation, such an estimate comes very close to being a true incremental policy cost estimate. However, if a later base year is chosen, confusion arises. For example, recent EPA estimates of the costs of pollution control for leather tanners use an apparent 1977 base year. The estimates of expenditures to be incurred include the expected expenditures of those plants that have yet to install 1972-mandated controls, and the estimates exclude the already incurred expenditures of those plants that meet the 1977-mandated controls. While these expenditure estimates are of interest, they are extremely difficult to use as estimates of the costs of either the 1972 or the 1977 regulations.

The simple identification of costs with expenditures has also led to inconsistent accounting for land and capital costs. Certain contractors have neglected the costs of these factors if they were already owned by the enterprise. (Often this is the case with land.) Others have attempted to capture the true opportunity costs of these already-owned factors by imputing their rental values (although rather crudely).

If EPA should decide to upgrade its cost analyses, a fundamental change will be required in the current approach. Under the current procedures, costing analysis begins with an analysis of the technical requirements of proposed regulations. Indeed, engineers--not economists--provide unit cost estimates in the "Development Documents." The "Economic Analysis Documents" rely upon these estimates for their analysis of industrywide cost effects.

While this approach may appear perfectly reasonable, it overlooks the fact that technical choice often--if not, always--has an economic foundation. Thus, the decision to use multiple lagoons rather than an activated sludge plant and decisions specifying the capacity of either approach depend upon site specific land, labor, and capital costs as well as upon technical feasibility.

It is quite possible (and it may be worth the experiment) to do the economic analysis before the technical analysis--that is, to specify a "tolerable" cost level and then ask the engineer to specify a technology consistent with that cost. This approach might have the advantage of stimulating innovative technical approaches. However, it has the distinct disadvantage of ignoring desired effluent limitations.

Therefore, it seems that a compromise approach, requiring close interaction between engineering and economic analysis, is called for. Establishing this close liaison will not be easy. It will require internal changes within the EPA bureaucracy as well as new arrangements with EPA contractors.

IV. RECOMMENDATIONS*

1. EPA should make more use than it now does of benefit evaluations in making decisions about programs and specific regulations.

An estimate of the extent of the benefits which will be gained from a program or regulation is essential for both arriving at sound decisions and making a persuasive case for the justifiability of a proposed decision. It does not require a profound knowledge of economics to raise the question of what society will gain for the resources expended on government programs. It is a question that deserves to be answered for both entire programs and specific regulations.

In many cases, it will be possible to provide only a very rough approximation of the benefits. Also, often the benefit estimates will not be in a form to allow direct comparison with monetary costs. Nevertheless, a reasoned comparison of the benefits, in whatever form the estimates take, with the costs should be an integral part of the decisionmaking process and the public explanation of the decision.

2. EPA should expand its basic research program on methods for estimating and evaluating benefits.

If greater use is to be made of benefit estimates, then additional research of all kinds will be needed to improve the quality of such estimates. Section III of this report indicated some of the research that is necessary. Also, insofar as the benefits will not be expressed in monetary units, as will frequently be the case, research is needed on how best to compare benefits in nonmonetary units with each other and with monetary costs.

If monetary measures of benefits are to be derived for comparison with costs, monetary values or "prices" must be estimated for beneficial effects. In some instances, such as agricultural crop losses, the determination of values from market data is relatively staightforward. In other cases, such as reduced mortality, the question of valuation is controversial and problematic. But for a variety of issues, such as visibility or recreation, EPA should continue its basic research program on the development and assessment of valuation methods. As information from these research efforts becomes available, it should be utilized in the economic analysis of the effects of regulations and programs.

* Dr. Wassily Leontief, Co-Chairman of the Subcommittee, has abstained from accepting the conclusions and recommendations of this report. His reasons are detailed in Appendix A.

3. A uniform set of concepts, definitions, and formats should be used in all EPA analyses of proposed regulations, except when deviations are clearly required, in which cases these should be pointed out and explained.

Presently there is a lack of consistency in definitions and analytical approaches which makes it impossible to synthesize the sectoral information developed in th separate EPA divisions. The quality of the analyses performed also suffers from this diversity.

The recommendations of the Water Resources Council* (WRC) for the preparation of benefit-cost analyses provide a good starting point for a uniform set of concepts to be applied in EPA, though some modifications will no doubt be advisable. In particular, the proposals of the WRC for estimating and displaying the costs and benefits accruing to significant segments of the population should be followed. Another important step for the Agency would be to adopt uniform projections of population and economic development, such as the OBERS projections, as a basis for analyzing regulations. EPA's Office of Planning and Management should assume responsibility for developing and enforcing the use of uniform analytical concepts, definitions, and formats. Development of an Agencywide handbook for doing cost analyses might be a first step in this direction.

4. To facilitate the choice among regulatory alternatives, the report of the analysis should display prominently the terms of "trade-offs" among them.

In notices of proposed rulemaking and other documents describing regulatory choices, EPA now frequently describes only one regulatory option and gives cursory attention to possible alternatives. It would be preferable if the advantages and disadvantages of different options were described. Specifically, the options might be listed in order of the costs that they impose on the industry or complying firms; tables and graphs should be included to show for each option the additional costs it imposes in comparison with the option that precedes it. The tables and graphs should also compare the options on the basis of protection they afford public health, environmental amenities, and other significant environmental conditions. We recognize that the data may not be available to show such trade-offs with great accuracy or in great detail, but it is still better to show the best available estimate of the trade-offs than to present decisionmakers or the public with an all-or-nothing choice.

* Federal Register, Vol. 38, No. 174 (September 10, 1973), pp. 24778 ff.

5. The estimates of costs and benefits used by EPA should be quantitative insofar as possible. The quantitative estimates should be translated into monetary equivalents when reliable prices are available or when there is some other reliable basis for making the translation, but not otherwise. Estimates that are not monetized should not, for that reason, be given less weight in decisionmaking than estimates expressed in dollar terms.

Some of the benefits and costs of environmental regulations will be represented by changes in the actual dollar costs incurred and by dollar revenues received by households, businesses and public bodies directly or indirectly affected by policy measures whose effects are assessed. However, many of the most important positive and negative effects of environmental regulations cannot be measured in terms of directly ascertainable dollar figures. The valuation of health, recreational facilities, and the qualities of the natural environment in which we live would involve application of measuring scales lying far beyond the area of directly observable facts. That distinction is very important for efficient organization of the assessment process.

The task of ascertaining the fact, for example, that a particular manufacturing process is accompanied by release of a volatile substance that, in its turn, can be expected to increase the frequency of certain respiratory ailments and of finding out about how many working days and income dollars can be expected to be lost because of these illnesses is one thing. It is quite a different thing to put a dollar value, as a number of studies have, on the shortened or lost human lives resulting from such a sequence of events.

The first is a technical factfinding task; the second is a decision involving human judgment. To exercise such judgment without possessing all possible factual information would be irresponsible, but to assume that the knowledge of all relevant facts could enable the policymaker to make his final choice without an exercise of judgment is plainly wrong. Any such judgment must, moreover, consist of a carefully considered choice between two or more alternative scenarios--each detailed vividly with much factual detail--not a comparison of two abstract, at least partly arbitrary, dollar figures, one supposedly representing the total "costs" of a given change and the other the aggregate "benefits," as if it were a simple commercial transaction.

6. In all cases, estimates of costs and benefits should be accompanied by statements of ranges that indicate the degree of imprecision and uncertainty in the estimate.

Without confidence intervals, it is impossible to judge the validity of the data. As a general guideline, the lower end of the range shoud be the greatest value that the analyst is confident does not exceed the true value. Specifically, the target should be that the true values, if they could be known, would not be below the lower ends of the ranges more than about five percent of the

time. The upper ends should be similarly defined. Of course, the exact confidence values aimed at are not important; what is important is that the confidence with which the ranges are believed valid is the same in all analyses.

7. The economic analysis functions and capabilities of the non-program offices of EPA should be expanded and strengthened.

There are a variety of functions or activities related to economic analysis that should be undertaken by a centralized non-program office in EPA. Additional resources and the full support of the EPA Administrator are necessary if these activities are to be successful.

With respect to estimates of the benefits of EPA regulations and programs, the office should 1) review existing studies of estimates of environmental benefits; 2) assemble, on an ongoing basis, estimates of the benefits of the total EPA regulatory program and of specific EPA regulations; and 3) stimulate ORD to undertake or contract for studies designed to fill in gaps which now exist in benefit estimates or in methods to improve the reliability of such estimates.

The office should undertake additional special studies. Examples of such needed studies include the effect of environmental regulations on the slowdown in productivity growth, the effect of environmental regulations on the level of and delays in capital investment, methods for introducing economic considerations in setting the level of particular regulatory standards, and the economic costs and benefits of substituting taxes, charges, and other economic incentives for existing policies of direct regulation. The Office of the Assistant Secretary for Planning and Evaluation in the former Department of Health, Education and Welfare (DHEW) and the Office of the Assistant Secretary for Evaluation and Research in the Department of Labor (DOL) are useful models for the way in which the EPA office should function.

The office should report periodically on the status of data necessary for economic analysis, including a criticial evaluation of the quality of such data. Since these data--especially cost data--are widely consumed, EPA has a responsibility to make users aware of the relative weaknesses or strengths of the data. Also, a periodic report may serve to focus future data development efforts.

8. Economic and technical analysis should be fully integrated in the preparation of estimates of the costs of regulations.

Currently in EPA the technical or engineering analysis "drives" the economic analysis of the cost of a regulation. The technical analysis implicitly assumes certain economic conditions. In fact, the efficient technical response to a regulatory requirement cannot be identified without taking into account its costs to the industry, its social costs, and its other economic effects. Thus the economic factors need to be considered at the same time as do the technical factors.

9. EPA analyses of regulations should incorporate consideration of nondirect costs. The methodologies to analyze these types of costs, including methods to study the effects of alternative policy implementation mechanisms, need to be improved.

Most of the current studies implicitly assume that the sole impact of regulations on the regulated industry is due to the direct resource costs of the regulations. However, many of the most important economic effects of regulatory action are nondirect costs, such as the impact of regultions on industry concentration, innovation, capital investment, and delay and uncertainty. Therefore these considerations should be an integral part of regulatory analysis.

The effects on industries of policy implementation mechanisms should be explicitly studied. The implementation mechanism and even the method of rulemaking can have profound effects on profit expectations and competitive structure. These factors, in turn, can have far more effect on the economic performance of the industry than the direct resource costs have.

10. EPA's program of basic research on the effects of changes in pollutant levels should be continued. There should be more consideration of economic analysis in the design of such research.

Because of limitations in our knowledge of changes in environmental quality associated with specific programs and regulations and of basic physical, biological, and behavioral relationships such as dose-effect functions for human health, it is frequently not feasible to obtain accurate estimates of the magnitude of beneficial effects in categories such as improved human health, increased opportunity for water-based recreation, improved visibility, and so forth. Yet, given the magnitude of the resource commitments to environmental programs and the concern about the net impacts of regulations, it would be extremely useful to have better estimates of the magnitude of benefits actually realized. The aggregate effects of changes in pollutant levels are often influenced by economic adjustments (for example, changed agricultural cropping patterns in response to changes in oxidant levels; a person moving his residence in response to air pollution), and data on pollution effects sometimes are not suitable for use in benefits analysis. Thus, there should be more economic input into the design and implementation of basic research strategies for assessing changes in pollutant levels.

11. Monitoring data alone are not an adequate indicator of policy effectiveness. Modeling, at both the national and regional levels, is necessary

Regional monitoring data systems, such as STORET, are used to assess the progress of EPA policy. Unfortunately, this approach fails to appreciate that ambient environmental quality is affected by nonpolicy factors such as meteorology and the state of the economy. Analysis, frequently utilizing models, is necessary to

separate the effects of EPA policy from the effects of nonpolicy factors.

12. Within the context of additional modeling, EPA should explore the use of existing sectoral and regional models (both inside and outside of government) to estimate the impacts of EPA policies and, when feasible, to establish operating versions of existing models within EPA.

Numerous multisectoral, general equilibrium models have been developed to estimate the sectoral (industry, occupation) and regional impacts of public policy measures. These models employ a variety of data (e.g., microdata, statistically estimated behavioral relationships, etc.) and analytical methods (e.g., first-round simulations, simultaneous equilibrium solutions, etc.). Moreover, these models are at a variety of levels of development and reliability and are very costly to construct, develop, maintain, and improve. Many of these models do have significant potential for policy analysis--in particular, economic analysis of environmental regulations. The Subcommittee's recommendation is intended to encourage the realization of this potential while recognizing the high costs associated with such models.

13. EPA economists should work closely with the macroeconometric modelers responsible for the annual EPA - CEQ macroeconomic studies to improve the reliability of the cost and expenditure estimates used in the models and to specify and examine the relationships between environmental policy measures and economic behavior assumed in the models.

The EPA (in conjunction with CEQ) analyses, as represented by The Cost of Clean Water, The Cost of Clean Air, and the annual macroeconometric studies (first through the Chase and later the DRI models), have been valuable contributions to understanding the impact of environmental policies on the nation's economy. The quality and analytic rigor of these studies have improved with time.

Although the fundamental structures of the macroeconometric models employed have weaknesses, they do represent the current state-of-the-art. But the use of these models for estimating the macroeconomic impacts of environmental policies requires adaptation of these models and the use of assumed relationships between environmental policy measures and economic behavior. The estimates yielded by the models depend crucially upon these assumptions and upon the reliability of industry-specific cost and expenditure estimates developed by EPA. These estimates have serious weaknesses. The Subcommittee recommends that EPA undertake a major effort to improve the reliability of the cost and expenditure estimates and the incidence of these costs and expenditures over time. The macroeconomic analyses should be accompanied by sensitivity analyses to reflect the uncertainty of the cost and expenditure estimates. The estimates should also recognize the possibility of alternative technologies and innovations within industries. The existence of these choices and technical changes--as well as other economic considerations--can lead to order-of-magnitude differences in the estimates.

14. EPA should initiate conceptual planning for an integrating analytical system to incorporate different data bases and analytical models.

One of the more valuable roles that economists can perform in a research organization is to provide a framework for integrating the different research efforts and to link these efforts with the decisionmaking process. This should be reflected in an integrated system of models and data bases which promotes assemblage and analysis of data in a systematic context.

EPA did attempt to support the development of such a system several years ago. Called the Strategic Environmental Assessment System (SEAS), it attempted to combine all information into one huge computer model. There were a number of shortcomings with this effort, and after several years it was essentially dropped. This proposal is not for the resurrection of SEAS. However, the work done for that effort and many of the lessons learned during that period provide a strong starting point for the development of a more useful integrating analytical system. The resulting system would probably differ from SEAS in many respects but would also make use of some of the components of SEAS. The fact that these components already exist (and in some cases have undergone further development and improvement elsewhere), combined with the expectation that many of the functions undertaken by the integrating system ought to be done whether there were such a system or not, makes this proposal a less expensive development effort than might otherwise be expected.

Currently EPA spends substantial amounts of money collecting data on such items as the number of firms in an industry, production, consumption, emissions, health effects, and the general state of the environment. But these data are so collected and processed that they can be used for only very limited purposes--if they are used at all. There is no attempt made to fit the data together and preserve them in a way in which they can be easily used for subsequent analysis. There is also a distressing lack of quality control and consistency in the data collection efforts.

Some of the important functions that an integrating model can provide follow:

1. It can provide a depository for data, one that is designed to be used not just to provide dead storage.

2. It can automatically provide a method of linking the various data sets.

3. It can force a measure of quality control and consistency on the data collection efforts.

4. It can allow the same basic data to be analyzed from many different perspectives.

Thus, the development of an integrating model, undertaken with a specific purpose of incorporating the data presently being collected by the Agency, becomes a major tool in improving data collection, lowerig data processing costs, improving data analysis, and providing a guide for new data collection.

The majority of the Subcommittee, although recognizing the utility of an integrating analytical system, believes that such a system has important limitations and would not replace the need for sectoral and other types of models to analyze regulatory impacts. The Subcommittee is also concerned that the resources devoted to such a system be kept within strict limits and not be diverted from other types of analytical efforts.

APPENDIX A

Views of Dr. Leontief

NEW YORK UNIVERSITY
Institute for Economic Analysis

Wassily Leontief, *Director*

May 22, 1980

Mr. J. Clarence Davies
Executive Vice President
The Conservation Foundation
1717 Massachusetts Avenue, N.W.
Washington, D. C. 20036

Dear Terry:

As far as I am able to judge, your Draft presents an adequate description of the role that economic analysis now plays in the activities of the EPA and it expresses very well the general endorsement by an overwhelming majority of members of our committee of the continued use by EPA economists of the conventional "economists' tool kit"--as one of our colleagues has called it--on which they have been relying up to now. I, on my part, find this approach to be quite inadequate particularly in dealing with problems involving close collaboration with scientists and engineers on the one hand, and biologists, ecologists, and health experts on the other.

I am fully aware of the problems encountered eight years ago with SEAS. But our Committee would not have been appointed if the economic work as carried on now had satisfied the present, not to speak of the future, needs of the EPA.

A shift from a well established old system to a new more ambitious system would take time, but I am convinced that it will not take place at all unless a carefully formulated program of transition from one system to another were put into effect.

251 Mercer Street • New York • New York 10012 • (212) 598-2181

A fuller more systematic presentation of the role that economic analysis should play in the development and implementation of National Environmental Policies was offered in the report of the Economic Solutions Advisory Group, entitled, "Evaluation of Current Environmental Research and Establishment of Priorities," and also in the brief memorandum, "Preliminary Observations on Assessment of Costs and Benefits of Environmental Regulations," that I sent to you on December 6, 1979.

I hope that after reading this statement the other members of our committee, as well as the readers of this report, will understand why I have decided to abstain from signing it.

Sincerely yours,

Wm

WL/mh

Preliminary Observations on Assessment of Costs and Benefits of Environmental Regulations

The assessment of benefits and costs of environmental regulations should in my opinion be carried out in two distinct, separate steps.

The first should aim at a systematic, detailed and, whenever possible, quantative description of all relevant direct and indirect repercussions of a policy action (or a combination of policy actions) the benefits or cost of which have to be assessed. The chains of anticipated effects will in most instances be found to stretch forward from immediate physical and chemical to biological and finally human health effects, aesthetic effects and backward through construction of requisite abatement facilities and additional labor and energy required to operate them toward more general economic repercussions such as shifts in industrial location, plant closings with resulting unemployments and so on.

The fact finding and analytical tasks involved in this first step will obviously require a close cooperation between experts in many different fields, only one of which is economics.

Methods of measurement will at this stage have to be different from field to field; particulars' emissions are usually measured in pounds, health effects in term frequencies of certain types of ailments, life expectation or number of labor days lost because of that. Capital requirements and unit costs and incomes are usually measured in dollars, employment in man years, output levels of steel in tons, energy in KWH's.

The second phase of the assessment process should consist of a final comparison of costs and benefits assigned separately or in toto to the direct and indirect repercussions of the policy action in question, repercussions which should have been already ascertained and systematically described in the first phase.

Some of these benefits and losses will be found to be represented by changes in the actual dollar costs incurred and dollar revenues received by households, businesses and public bodies directly or indirectly affected by policy measures whose effects we try to assess. However, many of the most important positive and negative effects of environmental regulations cannot be measured in terms of directly ascertainable

dollar figures. The valuation of health, of recreational facilities, of the qualities of natural environment in which we live, would involve application of measuring scales lying far beyond the area of directly observable facts. That distinction is very important for efficient organization of the assessment process.

The task of ascertaining the fact that a particular manufacturing process is accompanied by release of a volatile substance that in its turn can be expected to increase the frequence of certain respiratory ailments and of finding out about how many working days and income dollars can be expected to be lost because of these illnesses is one thing. It is a quite different thing to put a dollar value on the physical discomfort or, as the case may be, the shortened or lost human lives resulting from such a sequence of events.

The first is a technical fact-finding task, the second is a decision involving human judgement. To exercise such judgement without possessing all possible factual information would be irresponsible, but to assume that the knowledge of all relevant facts could enable the policy maker to make his final choice without an exercise of judgement is plainly wrong. And such judgement must moreover consist of a carefully considered choice between two or more alternative scenarios -- each detailed vividly with much factual detail -- not a comparison of two abstract, at least partly arbitrary, dollar figures, one supposedly representing the total "costs" of a given change and the other the aggregate "benefits" -- as if it were a simple commercial transaction.

My second set of comments is in favor of employing a unified, systematic modelling approach to be used not only in (aggregative) analysis of the general economic repercussion at environmental policies but also in tracing the direct and indirect (positive and negative) effects of special rules and regulations. The Report on Economic Solutions prepared by my working group at the symposium on "Evaluation of Current Environmental Research" held at the University of Pennsylvania in May, 1979, (made available to members of our committee) contains a similar recommendation which presents the arguments summarized below much more fully. Since at least one and possibly more members of our committee seem to disagree with that position, I anticipate the possibility that our final report might have to contain two separate statements on that subject.

The arguments in favor of comprehensive modelling approach and against continuing reliance on the "conventional economic tool kit" now employed in the EPA, can be summarized as

follows:

1. Comprehensive formal modelling is the only viable approach to factual description of the structure and analysis of functional properties of large, complex systems within which the policy makers in the field of environmental regulations have to operate. It is the only approach that permits systematic tracing of multidimensional relationships between the physical, biological, economic and social repercussions of any single or a given combination of several environmental regulations. It does provide at the same time and for the same reason concrete detailed specifications for construction and maintenance of the unified data base indispensible for shaping and implementation of efficient and effective environmental legislation.

2. The SAES system constructed some eight or nine years ago did not perform as well as originally expected precisely because:

a) it was the first and only try, within the EPA, in this particular direction -- a "spruce goose" (I refer to Howard Hughes' giant wooden plane) that was not permitted to be followed up by future efforts that could have been confidently expected to lead toward development of an efficient and well behaving modern "747" model.

b) not only the construction of that model and the compilation of the requisite data base, but even its operational use was put in the hands of several outside contractors.

Experience has shown that to gather the practical benefits of a new modelling enterprise it is imperative to carry it out with fullest possible cooperation and participation on the one hand of all those members of the organization (in this case the different divisions of the EPA regional laboratories, as well as local, i.e., state and municipal environmental agencies) that is expected to benefit from its practical use and on the other -- of those insiders and outsiders who happen to be in possession of the various types of primary information that will have to be included in the models data base.

3. Reliance on the "economist's usual tool kit" means continuation of the present free wheeling casual approach to the economic assessment as it is being practiced now. Adding more economists here and there and changing the organization chart would mean not more than increasing the size of the orchestra and rearranging its seating order; the music will remain the same and it will continue to sound as it does now -- more like the tuning up of the different instruments rather than performance of a well composed piece.

APPENDIX B

Charge to the Subcommittee

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAY 24 1979

THE ADMINISTRATOR

Dr. John E. Cantlon
Chairman
Science Advisory (A-101)
U.S. Environmental Protection Agency
Washington, D.C. 20460

Dear Dr. Cantlon:

As recommended by the Executive Committee of the Science Advisory Board I agree with the need for the formation of a subcommittee to review the "state of the art" of economic analysis as it is done by the Agency. I welcome the establishment of the Economic Analysis Subcommittee and look forward to receiving their comments on the following issues:

- What resources is EPA devoting to economic analysis
- What steps should the Agency take to improve the analysis of the benefits of its regulations
- An examination of EPA's research and analytical efforts on the costs of regulatory measures

Again, I look forward with interest to receiving your advice.

Sincerely,

Douglas M. Costle