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ABSTRACT

ACCOUNTING INFORMATION FOR ENVIRONMENTAL DECISIONS

By

Myles Stern

In order to delineate the ways in which the accounting function relates to decisions regarding environmental disruption and its control, this dissertation addresses the following four questions, in the order stated:

1. What is the nature of the environmental decisions made by government agencies, business managers, and private individuals who use published financial reports?
2. What information is relevant to these decisions?
3. What portions of this information might reasonably be supplied through the accounting function?
4. By what means and to what extent could accountants gather, report, and audit such information?

The methodology employed to attack these questions begins with the presentation of conceptual descriptions, drawn largely from the literature in accounting and economics, of the decisions mentioned in question one above. The second step, for decisions made by government agencies and business managers, comprises an empirical study of the activities of a regional air pollution control agency and a large utility firm respectively. Finally, based upon both the conceptual structures and the

empirical findings, conclusions are formed in response to all four questions.

After surveying the current regulatory status of environmental disruption, including existing reporting requirements, the focus shifts to governmental decisionmaking at the national and regional levels. While this subject is important in itself, it is especially crucial because government decisions control the framework within which firms and individuals must make their decisions. Specific economic models are presented to furnish (1) a foundation for discussing economic aspects of disruption and its control; (2) an a priori basis for assessing the effectiveness and efficiency of alternate regulation strategies; and (3) a concrete approach for evaluating individual factors under benefit-cost analysis--the essential method by which government agencies can select among alternative environmental proposals. The information that government agencies require to implement these concepts is described. Following this treatment of governmental decision-making, the dissertation turns to the decisions made by and the corresponding information needs of firms and individuals.

Conclusions are drawn about the relationship of the accounting function to environmental decisions made at each of the three levels: government, firms, and individuals. For government agencies, much of the information relevant to economic analysis pertains to financial characteristics and activities that are recorded in accounting systems of individual firms. Typically, in using such accounting data,

economists encounter problems concerning asset valuation, depreciation, the cost of capital to the firm, and the inter-relationships among individual cost factors. Accountants could help ameliorate these difficulties by applying current costing to assets and depreciation charges; by disclosing more fully the nature of and the returns to individual classes of a firm's security-holders; and by describing, for each material cost item, its behavior, the segment of the firm with which it may be directly identified, and the underlying purpose and necessity for its incurrence.

The empirical findings about a particular agency are used to help specify the scope of the accounting function within such government units. By designing report forms to be submitted by subsidiary agencies and individual firms, and by participating in benefit-cost studies based partly upon accounting data for individual firms, accountants can contribute to the development of environmental regulations. The case study further demonstrates that accounting for the administrative aspects of these agencies is both essential and fully consistent with the "conventional" accounting function. A specific proposal for a computerized information system for the agency studied outlines the manner in which accountants can become involved meaningfully in such systems design efforts.

Within a particular firm, accountants must determine, as part of their usual function, the extent to which environmental disruption and its abatement bear upon the entity's financial statements furnished stockholders and government

agencies. Moreover, the study of an actual set of decisions made by a utility firm clearly delineates the kinds of reports the accounting function must provide to managers for coordinating environmental policies with the firm's overall goals, for making specific environmental decisions within a capital budgeting context, and for controlling environmental projects. Examples are taken from the case study to support the contention that, within businesses as within government agencies, accountants must play a major role in designing comprehensive, environmental information systems: the same principles that underlie the structuring of effective accounting systems apply to these systems as well.

In order for users of reports published by individual firms to be able to rely on the information contained therein, generally-accepted standards must govern their preparation and some type of independent examination must be conducted. A suggested format for such reports includes a background description of the firm's disruption concerns and its abatement goals and progress as well as a financial summary linking environmental items to the conventional statements of income, financial position and changes in financial position. It appears likely that public accounting firms or groups of social auditors, rather than government auditors, will increasingly be called upon to study such reports. Independent accountants could "attest" to the environmental financial summaries and could provide a somewhat lesser "degree of assurance" about the background descriptions.

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By

Myles Stern

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For Laura and Rebecca

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I. INTRODUCTION AND METHODOLOGY

Purpose and Scope of this Dissertation

During recent years, increased public awareness and concern about environmental disruption had led to a multitude of actions and calls for further action. Unfortunately, so many of these programs reflect a viewpoint restricted to a particular environmental problem that many people are now bewildered by the overabundance of plans and counterplans.

A chief reason for this confusion is the staggering array of environmental decisions that must be made by governments, businesses, and individuals. If a truly comprehensive and coordinated approach to obtaining environmental quality is to be developed, it is mandatory that these decisions be made in a sound manner. Accordingly, they must be based upon information that is relevant, useful, and complete. In essence, the purpose of this dissertation is to investigate the ways in which the accounting function can help supply the information that is required for environmental decisionmaking.

Many researchers and practitioners in the "systems" area have concluded that the best way to develop an information system is to have the individual who will be using the system play a major role in specifying just what should be

included.¹ At the same time, however, "systems analysts" generally recognize that the typical user is not fully cognizant of his own needs and is largely ignorant of the range of possible features that might be included in the system! Since the environmental decisionmaker's area of interest is so new and fast-changing, he is especially prone to have imperfect notions of his information needs and of potential provisions for his information system. Thus, "information specialists" must actively help the user to specify the system.

Following this line of reasoning and in order to delineate the ways in which the accounting function relates to decisions regarding environmental disruption and its control, this dissertation will address the following four questions, in the order stated:

1. What are the natures of the various environmental decisions made by government agencies, business managers and private individuals who use published financial reports?
2. What general kinds of information are relevant to these decisions?
3. What portions of this information might reasonably be supplied through the accounting function?
4. By what means and to what extent could accountants gather, report, and audit such information?

¹John Dearden, "Systems Organization and Responsibility," in Managing Computer-Based Information Systems, ed. by John Dearden, F. Warren McFarlan, and William M. Zani (Homewood, Illinois: Richard D. Irwin, 1971), p.591.

Prior to detailing the methodology by which these questions will be answered, some attention will be given to the characteristics and scope of the accounting function and to the reasons, cited in the recent literature, for accountants to become involved with environmental information.

The Nature of Accounting

A committee of the American Accounting Association has stated that "there is considerable dispute as to what is and is not accounting. Any guidelines . . . to classify information . . . as being 'accounting' or 'non-accounting' information would be extremely arbitrary."² While it does seem quite unreasonable to attempt to provide a precise definition of "accounting," it is still useful to explain the general sense in which this term will be used in this dissertation.

Accounting has been described "as the process of identifying, measuring, and communicating economic information to permit informed judgements and decisions by users of the information."³ Carey points out that

CPAs measure and communicate . . . data largely for control and information purposes, most frequently for an economic entity--a business, a governmental unit, a nonprofit organization. Other experts analyze similar data, but

²"Report of the Committee on Non-Financial Measures of Effectiveness," The Accounting Review, Supplement to Volume XLVI (1971), p.167.

³Committee to Prepare a Statement of Basic Accounting Theory, A Statement of Basic Accounting Theory (Evanston, Illinois: American Accounting Association, 1966), p. 1.

usually for more specialized purposes--sometimes broader, as in the case of economists in estimating national income or gross national product; sometimes narrower, as in the case of a statistician concerned with only one phase of a business, such as market surveys.

Accounting deals with the processing of data within, the overall reliability of, and the generation of reports from information systems. In order to provide credible information to decisionmakers, accounting embraces the notion of internal control and incorporates the audit function.

In these pages, the term "accountant" will be used to denote an individual who, by virtue either of formal education or on-the-job training, holds, or is qualified to hold, a position of "staff accountant" within a government agency, a commercial firm, or a public accounting firm.

Accounting and Environmental Quality

At least three reasons have been advanced for accountants to become more involved with developing reports for environmental decisionmaking. These reasons will be discussed in the following paragraphs.

Management advisory services.--The environmental area

⁴John L. Carey, The CPA Plans for the Future (New York: American Institute of Certified Public Accountants, 1965), pp. 117-18.

represents an important opportunity for public accounting firms to expand their offerings of management services. Indeed, the chairman of the AICPA's Committee on Environmental Accounting has concluded that "during the next 10 years, environmental management engagements will afford perhaps the major new field for client service in which all practitioners can participate."⁵ Furthermore, two recent reports demonstrate the feasibility of accounting firms providing such services to government agencies as well as to private companies.

The first report explains how, in conjunction with Pennsylvania's Bureau of Sanitary Engineering, a group of management advisory services specialists from Price Waterhouse designed an information processing and retrieval system for statewide water quality data.⁶ While the primary objective of the program was to "establish a workable information system for planning, directing, evaluating, and administering the water quality management program of the state as a whole;" an important second goal was to develop a general approach which might be followed by water pollution regulators in other states.⁷

The second article details how members of Touche, Ross helped plan a management information system for Detroit's

⁵William G. Gaede, "Environmental Management Opportunities for the CPA," The Journal of Accountancy, May 1974, p. 54.

⁶Henry S. Sawin, "The CPA's Role in Restoring the Ecological Balance," Management Advisor, March-April, 1971, pp. 23-29.

⁷Ibid., p. 24.

anti-poverty program.⁸ While this project did not deal specifically with environmental disruption, it did show the general possibility of quantifying social wants and needs. This same sort of assignment presumably could be performed by accountants working to solve other social problems.⁹

While the Price Waterhouse project is an example of applying conventional techniques to a new situation, the Touche, Ross engagement represents a conceptual extension of the accountant's role. Taken together, these two studies indicate that accountants may provide valuable management advisory services, in connection with environmental disruption problems, to government agencies.

Mandatory reporting and auditing requirements.--As will be examined closely in later chapters of this dissertation, business firms are currently required to submit a good deal of information about disruption and abatement to various government agencies. Quite often, accounting personnel have primary responsibilities for the preparation of these reports. Moreover,

⁸Robert Beyer, "The Modern Management Approach to a Program of Social Improvement," The Journal of Accountancy, March, 1969, pp.37-46.

⁹There has been some debate on the extent to which accountants should become involved in the evaluation of social programs. Some questions concerning the competence of accountants to do such work are discussed in M. E. Francis, "Accounting and the Evaluation of Social Programs: A Critical Comment," The Accounting Review. April 1973, pp. 245-57.

independent accountants, in order to give opinions on published financial statements, must consider the adequacy of disclosure pertaining to the firms' environmental affairs. These requirements for environmental reporting and auditing seem likely to expand in the future.

Social responsibilities of accountants.--Arguments

have been advanced that the accounting function has a collective "duty" to society to become actively involved in the resolution of environmental problems. One such line of reasoning begins with the observation that the accounting function's primary purpose in society is to provide information used ultimately as part of the basis for capital expenditure decisions.¹⁰ Since accounting has generally ignored information about the environmental disruption caused by a firm's operations, the profession has been partly to blame for the inefficient (from society's viewpoint) capital allocations which followed. In addition, there is good reason to believe that if accountants do not provide this kind of information, the task will likely be performed by individuals having weaker credentials. These concerns are clearly voiced by Beams and Fertig:

Accounting as an organized profession has the responsibility to transcend the internal viewpoint of a private firm and to develop information which portrays a private firm's role in and contribution to society . . . The current concern for pollution control and environmental replenishment has

¹⁰James E. Parker, "Accounting and Ecology: A Perspective," The Journal of Accountancy, October 1971, p. 44.

created a new urgency for the profession to accept an active role in regard to social costs. On the one hand, accounting is being criticized for contributing to the decay of our environment and, on the other hand, new organizations are being formed to provide information relating to the social responsibility of corporations These organizations are without standards, without discipline and lacking the professionalism of accountancy with its guardian, the AICPA.¹¹

Although the acceptance of accounting's social role is not unanimous, it does appear to be growing widely, as witnessed by the efforts of committees from the AICPA and the American Accounting Association.¹²

In short, because of opportunities for expanding management services, mandatory reporting and auditing requirements, and their acceptance of social responsibilities, accountants are becoming increasingly involved with environmental information.

The Methodological Approach

The goal for this study is the specification of the potential role for the accounting function in developing the information systems required for environmental decisionmaking by government agencies, businesses, and individuals; as well as

¹¹Floyd A. Beams and Paul E. Fertig, "Pollution Control Through Social Cost Conversion," The Journal of Accountancy, November 1971, pp. 38-39.

¹²A much more restricted view of accounting's function is given in William A. Paton, "Earmarks of a Profession--And the APB," The Journal of Accountancy, January 1971, pp. 37-45. AICPA committee efforts are described in Marshall S. Armstrong, New Thinking on Environmental and Social Problems (New York: American Institute of Certified Public Accountants, 1971), p. 12. The work of the AAA is discussed in Beams and Fertig, op. cit., p.38.

in obtaining, communicating, and auditing the actual information that is relevant to such decisions. In order to substantiate this proposition, explicit answers must be provided to the four questions posed on page 2.

Before any specific investigation of environmental decisionmaking can be begun, its general context must be understood. Accordingly, descriptions of the categories of environmental disruption and of the possible approaches to control will be supplied later in this chapter. Moreover, the next chapter will discuss current environmental regulations--and reporting requirements thereunder--as well as attempt to provide some feeling of where the U.S. is today, along the continuum from primitive environmental controls to mature ones. After the next chapter, the dissertation will focus more narrowly on environmental decisionmaking. At this point, however, a detailed preview will be made of the manner in which answers to the four basic questions will be obtained.

Governmental decisions.--The study of decisions made at this level is crucial for two reasons. First, important environmental decisions are often made by government agencies and accountants may have a role to play with respect to the information required. Second, the study of governmental decisionmaking will provide a description of the overall context within which firms and individuals must make their decisions. This section will commence with a description of three economic models drawn from the recent economic literature. These models will be included in the dissertation to furnish (1) a conceptual

foundation for discussing economic aspects of disruption and its abatement; (2) a basic for forecasting the effectiveness and efficiency of different control strategies; and (3) a concrete approach for evaluating individual benefits and costs of alternative environmental proposals.

After these theoretical models have been presented, the numerous social, political, and economic constraints that face the governmental decisionmaker will be discussed. Following that, there will be an examination of the considerations underlying the development of a theory of governmental, environmental decisionmaking. The use of benefit-cost analysis in the selection of public programs will be analyzed and a precise formulation of that method will be provided. In addition, a less-rigorous but possibly more-pragmatic approach to such decisionmaking will be outlined. The dynamic aspects of disruption control will also be covered, in terms of how government agencies can and must plan for changes in environmental regulations. Finally, attention will be given to the kinds of information needed for decisionmaking by federal and regional regulatory agencies.

As a complement to the development of this broad, conceptual framework, a look will be taken at the activities of a particular agency responsible for maintaining air quality within a large metropolitan region. Based on the agency's published regulations and interviews with members of its staff, comparisons will be drawn between the workings of the agency and the theoretical concepts presented earlier.

Decisions by firms.--The study of environmental decisionmaking by managers of private firms will be conducted in much the same manner as described above for governmental decisionmaking. Again, a conceptual structure, drawn from the literature in accounting and closely-related disciplines, will be developed. The basic objectives of firms will be examined first. Subsequently, the three general types of environmental decisions that firms must make will be delineated:

1. Choosing a target level of compliance with environmental regulations,
2. Selecting an approach to achieve compliance in a particular situation, and
3. Maintaining managerial control over environmental projects.

After the natures of these decisions have been described, the information needs and problems of business managers will be considered. Finally, the alternative organizational structures that are being used for environmental decisionmaking will be reviewed.

Following this presentation of theoretical and general notions, a close inspection will be made of the environmental affairs of a large electric utility. Founded upon the firm's internal documents and in-depth interviews with accounting and environmental managers, this case study will outline:

1. The firm's overall attitude toward disruption abatement;

2. The firm's management structure for making environmental decisions;
3. The specific decision-model used by the firm;
4. The methods used to maintain managerial control over the implementation of environmental decisions;
5. The characteristics of the firm's accounting system, with particular emphasis on the availability of information for environmental decisions; and
6. The ways in which the firm might match its information needs to potential information sources.

Sulfur oxides.--Although this dissertation deals with all forms of environmental disruption, the two empirical investigations (of a regional agency and of a large utility) will specifically concern air pollution and its control. Two reasons dictate the narrowing of these case studies. First, air pollution happens to be the only form of disruption regulated by the agency and the primary disruption problem of the utility. Second, this approach leads to an analysis that is probably more cohesive than would have been possible without the narrowing of the subject.

In order to provide an even more direct link between decisionmaking at the governmental and firm levels, specific decisions pertaining to the control of sulfur oxides will be examined closely in both case studies. In the chapter dealing with the government agency, the development of National Ambient Air Quality Standards (by the Environmental Protection Agency) as well as specific, local compliance standards (by the regional agency) will be analyzed. In the chapter concerning the utility firm, decisions about ways to meet specific sulfur oxides

regulations will be highlighted.

Decisions by individuals.--The final category of environmental decisions to be surveyed will be those made by individuals who use published financial reports. Drawing mainly upon reports prepared by authoritative bodies and recent literature pertaining to social auditing, a conceptual framework will be synthesized. This framework will describe the characteristics of users of financial statements, the types of environmental decisions they make, and their needs for information. Lastly, the role of attestation in furnishing users with information that they may rely upon will be examined from the standpoint of three different types of audits: financial, operational, and social.

Formulating conclusions.--This broad analysis of environmental decisionmaking will, in itself, furnish answers to the first two issues raised at the start of this chapter: the nature of environmental decisions and the kinds of information that are relevant. The remaining two questions will be addressed in the two concluding chapters of the dissertation: what information might the accounting function supply and the means and extent to which accountants could gather, report, and audit such information. In general, these conclusions will be drawn in either or both of two manners. One, the attributes of environmental information will be compared to characterizations of accounting information that have been presented in the literature. Two, the environmental reporting and systems

design tasks that are or must be undertaken by government agencies and private firms will be compared with activities traditionally included within the Accounting function. In these ways, it will be possible to specify the potential scope of the accounting function as it pertains to environmental decisions.

Research in Socio-Economic Accounting

The subject matter of this dissertation overlaps, to some extent, the topic known variously as socio-economic accounting, social accounting, or social auditing. This subject has been widely discussed in the recent accounting literature and has generated a substantial amount of debate. In order that the present study's goals and methodology be most clearly understood, it seems imperative that the topic of socio-economic accounting be outlined and its connections to this dissertation be delineated.

The nature of socio-economic accounting.--Professor Mobley, for one, has pointed out that accountants have not agreed upon a precise definition for socio-economic accounting. She uses the term to mean "the ordering, measuring and analysis of the social and economic consequences of governmental and entrepreneurial behavior."¹³ Dilley lists five categories of

¹³Sybil Mobley, "The Challenges of Socio-Economic Accounting," The Accounting Review, October 1970, p. 762.

socio-economic accounting: "(1) the Application of Planning, Programming, Budget Systems (PPBS) to government and other non-profit entities, (2) a system of national 'social' accounts, (3) the development of internal managerial social accounts, (4) social responsibility statements for external reporting and (5) independent audits of those statements."¹⁴

At the national-governmental level, socio-economic accounting may be generally characterized as an extension of national income accounting, designed to provide a more meaningful barometer of the nation's well-being than is presented by such narrow, economic indicators as gross national product. Indeed, some economists have proposed that GNP measurements be replaced by or supplemented with measurements of "net economic welfare."¹⁵ Furthermore, it has been proposed that certain psychological measurements be taken concerning "the aspirations, expectations, satisfactions, frustrations, attitudes, and values of the American population and of its major subdivisions."¹⁶ Such social measurements would potentially be quite valuable in the formulation of national social policies. Indeed, it is envisioned that a comprehensive social report to the President

¹⁴Steven C. Dilley, Accounting for Externalities: Conducting a Social Audit and Preparing a Social Responsibility Annual Report for a Public Utility, unpublished doctoral dissertation, University of Wisconsin--Madison, 1972, p. 70.

¹⁵Laird Hart, "'Stagflation' Reminds Economic Professors How Little They Know," The Wall Street Journal, September 9, 1974, p. 15.

¹⁶Angus Campbell, "Social Accounting in the 1970's," Michigan Business Review, January 1971, p. 6.

could well be prepared.¹⁷

In addition to measurements related to "net economic (or social) welfare," socio-economic accounting also encompasses the analysis of costs and benefits pertaining to individual government programs. Such work is performed at both federal and regional agencies.

With respect to an individual firm, socio-economic accounting concerns multi-dimensional measurements of an entity's performance. The five dimensions proposed by the AAA's Committee on Measurement of Social Costs comprise: (1) financial performance, (2) human resource development, (3) public service, (4) environmental improvement, and (5) product quality.¹⁸ Methods have been proposed for preparing "social responsibility statements" which could be made available in much the same manner as are traditional, corporate annual reports.¹⁹ Some authors have urged that "social audits" of businesses be conducted in connection with furnishing "social responsibility" information to persons outside the firms. Such an audit might encompass the original preparation of a "social responsibility statement" by an interdisciplinary audit team, as

¹⁷Ibid.

¹⁸"Report of the Committee on Measurement of Social Costs," The Accounting Review, Supplement to Volume XLIV (1974), pp. 101-102.

¹⁹For instance, see David F. Linowes, "An Approach to Socio-Economic Accounting," The Conference Board Record, November 1972, pp. 58-61. Also see Steven C. Dilley and Jerry Weygandt, Measuring Corporate Social Responsibility: An Empirical Test, The Journal of Accountancy, September 1973, pp. 62-70.

has been suggested by Dilley and Weygandt. Alternatively, "social auditors" might attest, in a manner quite analogous to traditional, financial auditing, to a "social responsibility report" prepared by the firm's own management. The concepts and issues related to social auditing will be examined more closely in Chapter VIII.

The relationship of this study to
socio-economic accounting.--Since environmental quality is one of the dimensions of socio-economic performance; in a sense, the subject matter of this dissertation may be considered to be a proper subset of socio-economic accounting. However, this study considers environmental decisions made at three levels (government agencies, business firms, and individuals); while most of the recent literature on socio-economic accounting, written by and primarily for accountants, has centered about the development and dissemination of reports on the social impact of corporate activities. Thus, the overlap of this study with the "main thrust" of the recent literature on socio-economic accounting pertains to reporting the environmental ramifications of corporate activities. In short, while this is not specifically a study of socio-economic accounting, that subject does have some important connections with this dissertation.

With the topic and methodology of this investigation clearly in mind, attention may now be directed toward developing an analytical framework for the discussion of environmental decisionmaking. This task will start with a consideration of the

different types of disruption and of the different approaches to their regulations.

Types of Disruption and Abatement

Classifying Forms of Disruption

For the purposes of this dissertation, environmental disruption may be defined as any stress on a stable ecological system which ultimately has deleterious effects on humans. Although the following are not the only possible classification schemes for such stresses, they appear to be particularly useful for this study.

Natural or man-made.--While many instances of environmental disruption occur in nature, the general concern here is with those instances that are either man-made or man-aggravated.

Medium of disruption.--Probably the most widely-used classification scheme is one that separates environmental disruption into categories similar to the following: (1) air pollution, (2) water pollution, (3) solid waste disposal, (4) noise pollution, (5) visual pollution (scenic disruption), and (6) others.²⁰

²⁰ Similar schemes are used by many authorities. For example see Council on Environmental Quality, Environmental Quality--1970 (Washington, D.C.: U.S. Government Printing Office, 1970).

Type of damage.--Environmental disruption may also be classified by naming exactly what is attacked or damaged.²¹ Some useful categories might be: (1) inanimate objects, (2) plants and animals, (3) human health and comfort, and (4) human aesthetic sensibilities.

Possible Remedies

Many different methods for reducing environmental disruption have been identified in the literature of both the physical and the social sciences. Certain methods that appear to be particularly relevant to this study will be introduced below. Analysis of these various approaches will continue throughout much of the dissertation. In particular, the economic models to be described in Chapter III will furnish a basis for discussing the relative economic merits of alternative abatement strategies. The information required for implementing these strategies will be examined in Chapter IV.

Outright prohibition.--A particular type of disruption might be banned entirely, implying that either the production process would have to be modified so as to eliminate all disruption, or the process itself would have to be halted.²²

²¹Ibid., p. 16.

²²While the phrase "production process or consumption process" will be shortened to "production process" throughout this section, the reader should remember that the arguments apply to a consumption process also.

Many times, this second approach might be the only feasible way to comply with prohibition. Indeed, the ban is often placed directly on the process itself, as when prohibitions are made on the use of phosphate detergents or on trash burning by individuals, rather than on the resulting disruption.

Restrictive standards.--Absolute prohibition may be viewed as a standard containing a 100% restriction. However, many proposed standards would not be set this high. Restrictions may be placed on certain inputs to a production process (input standards), or they may be placed directly on the disruption generated by the process (output standards). Regulations proscribing the use of high-sulfur fuels are applications of the former method, while restrictions on the quantity of sulfur oxides spewing forth from smokestacks are applications of the latter.

Effluent charges.--One remedy widely recognized by economists would be to levy a tax on a producing or consuming unit based on the amount of disruption that the unit causes.²³ This tax might be levied at a flat rate per unit of disruption, or at progressive rates.

²³ Similar charges might also be based upon inputs to the process. However, the effects of the two approaches are likely to be different as output changes would easily accomodate input substitution. Theoretically, charges based on outputs are preferable since they are at least as efficient as charges based on inputs in all circumstances and they are more efficient in some.

Licenses.--A government agency might restrict a specific form of environmental disruption occurring within its jurisdiction by issuing a limited number of licenses or certificates, each of which would entitle the bearer to produce a predetermined amount of disruption.²⁴ No disruption in excess of the total represented by the outstanding certificates would be allowed. Under one such scheme, the government agency would sell transferable certificates at an auction. These certificates could be either used or resold by the purchaser. Alternatively, some plans call for the use of non-transferable licenses.

Subsidies.--A government may use direct payments as an incentive to producers and consumers for reducing their disruption. Although all such payments will be classified as "subsidies" in this analysis, they may take a number of different forms such as grants, tax credits, or tax deductions. These subsidies might be based on such considerations as investment in disruption abatement facilities, reduction in certain inputs to the production process, or reduction in the amount of disruption actually caused by the process. Many plans for rates and other conditions for these subsidies are possible.

Specific legal action.--Legislation could be enacted--the

²⁴Licenses may be viewed as a combination of restrictive standards and effluent charges.

state of Michigan has already done so²⁵--to encourage damage suits by individuals or governments, or as a class action which permits one individual to bring suit on behalf of himself and all others similarly damaged. Furthermore, the legal liabilities of disrupters could be more precisely delineated by statute.

A summary of the kinds of environmental disruption and the alternate approaches to their abatement was presented in the above paragraphs. The next chapter will examine the development of the regulations that are currently in force.

²⁵Michigan Public Act 127 of 1970.

II. THE CURRENT STATUS OF DISRUPTION ABATEMENT

In order to provide a basis for discussing decisions about environmental disruption, it is necessary to examine the present scope of control. In particular, this chapter will analyze the following topics: (1) the historical development of disruption abatement programs; (2) the major types of abatement legislation in effect today, and the administrative regulations and reporting requirements thereunder; and (3) the transition from primitive controls to the future state of nature and comprehensive controls.

The Historical Context

Although environmental disruption became a major, national issue in the mid-1960's, certain serious disruption problems have been recognized for centuries. Contamination of the drinking water was a widespread problem during the middle ages, and the London typhoid epidemics in the nineteenth century led to the first concerted attack on such disruption.¹ Smoke-filled air in heavily-industrialized regions has been a public health problem since, at least, the latter part of that

¹U.S. Council on Environmental Quality, Environmental Quality--1970 (Washington: U.S. Government Printing Office, 1970), p. 29. This publication appears annually.

century.² In 1948, a prolonged air pollution condition in Donora, Pennsylvania caused twenty deaths and nearly six thousand cases of illness.³ That incident dramatized the problem of pollution and appears to have hastened federal action. For over a hundred years, conservation groups in this country have fought to preserve natural mineral and wildlife resources.⁴

It seems reasonable to view the development of environmental disruption into a national political issue during the past decade as having been founded upon several intertwined factors. Air and water pollution was long regarded as a purely local or regional problem. Within the last twenty years, however, there has been a gradual acceptance by the public, the Congress, and the Federal administration of the national scope of disruption abatement. In part, this changed attitude was due to a growing perception both of the pervasiveness of environmental disruption and the interrelationships among its various forms. Important too was the general expansion of federal programs under a Congress and an administration controlled by Democrats during the Kennedy and Johnson years.⁵

²In 1881, the Chicago City Council adopted an ordinance declaring that dense smoke emitted from any boat, locomotive, or chimney was a public nuisance. J. Clarence Davies III, The Politics of Pollution (New York: Pegasus, 1970), p. 33.

³Ibid., p. 34.

⁴Environmental Quality--1970, p. 6.

⁵See James L. Sundquist, Politics and Policy: The Eisenhower, Kennedy, and Johnson Years (Washington: The Brookings Institution, 1968), especially chapter VIII.

During this period, pollution began to be recognized as a public nuisance whereas formerly it had been usually classed as either a public health hazard or a "conservation" problem.⁶ Lastly, significant interactions were identified among disruption and its abatement and such national economic goals as full employment and sustained growth of the Gross National Product. One effect of these combined factors has been the application of a "systems approach" to the study of environmental disruption, wherein individual forms of disruption are treated as components of a larger, more general problem.

This systems viewpoint has led to the identification of numerous forms of disruption in addition to water and air pollution, although those two forms remain the most severe and most studied. Accordingly, an analytical chronology of federal involvement in water and air pollution control will be presented at this point. Since Federal programs dealing with air pollution typically have followed and have been patterned upon similar programs dealing with water pollution, Federal actions in water pollution control will be discussed first.⁷

Water pollution abatement legislation.⁸--Before 1948,

⁶Ernest Boyce, "Air Pollution--Nuisance or Hazard," Michigan Business Review, May 1973, pp. 1-5.

⁷Davies, op. cit., p. 37.

⁸This section is based largely upon the previously-cited works by Davies and by Sundquist.

control of water pollution rested almost entirely with states and localities. Over a long period prior to this time, responsibility for control of water quality had slowly passed from municipalities to regional boards and state agencies. The impetus for this shift was the typical city's inability to control upstream sources of pollution and its disregard for downstream water quality. Within this era, only two minor federal acts were legislated to deal with water pollution. The "Rivers and Harbors Act" was intended to prevent the dumping of debris into interstate waters.⁹ Although recently used by the Nixon administration as a means of regulating the discharge of pollutants into waterways, the act was originally intended to enhance water navigability, not cleanliness. The "Oil Pollution Act," a largely ineffective piece of legislation, prohibited the leakage of oil from oceangoing vessels.¹⁰ In the 1930's, the Public Works Administration provided assistance for the construction of municipal waste treatment facilities, but this activity did not result from pollution control legislation.¹¹

In 1948, the federal government became involved explicitly with water pollution abatement. The "Water Pollution

⁹30 Stat. 1152.

¹⁰The Oil Pollution Act, 1924, 33 U.S.C. 431, et seq.

¹¹Sundquist, op. cit., pp. 323-24. The years of this program, approximately 1933-39, were the only period since 1900 when the municipal waste treatment plant construction matched population growth.

Control Act¹²" contained provisions for federal research programs, research grants to the states, grants for the planning of sewage treatment plants and low-interest loans to finance their construction, and federal intervention in pollution abatement programs. This last provision, however, while empowering the Public Health Service to hold hearings and issue recommendations, permitted federal enforcement only with the permission of the affected states.¹³ In anticipation of the renewal of the 1948 act, President Eisenhower proposed to Congress that the enforcement provisions be strengthened. The long congressional deliberations and the final passage of forceful amendments¹⁴ to the 1948 act constituted a significant milestone in the trend toward federal action for disruption control. Davis reports that

The new provisions represented a compromise between the Department of Health, Education, and Welfare . . . and the state health agencies. They provided for a conference among the interested parties, a public hearing if the conference did not result in action within six months, and then another six-month waiting period, after which the case could be taken to court. This became the basic pattern for Federal enforcement in both air and water pollution.¹⁵

¹²P.L. 80-845.

¹³As reported in Sundquist, op. cit., p. 324. Also, funds for the loan program were never appropriated.

¹⁴Water Pollution Control Act Amendments of 1956, P.L. 84-660.

¹⁵Davies, op. cit., p. 41. Emphasis added.

While the 1956 amendments retained the state consent provision, additional amendments passed in 1961 removed that provision and extended jurisdiction of the federal government to all navigable waters. These later amendments further provided for an increased grant program and appropriations were subsequently authorized.¹⁶

Early in 1963, the Senate Subcommittee on Air and Water Pollution was formed under the chairmanship of Senator Edmund Muskie of Maine. In 1965, the "Water Quality Act," which had been vigorously promoted in the Senate by Muskie and in the House by Representative John Blatnik of Minnesota, required the states to establish adequate water quality standards or have federal standards imposed. The Clean Water Restoration Act, passed in 1966, provided massive grants for the construction of waste treatment plants and provided quality standards for the bodies of water receiving the discharge of such plants.¹⁷ Sundquist comments that

Only six years after President Eisenhower had vetoed a . . . bill on the ground that water pollution was "a uniquely local blight," the Congress--without a dissenting vote in either House--had approved a program of full national leadership . . . with an ultimate spending rate twelve times as great as the level contemplated in the

¹⁶Ibid., pp. 41-43. Davies describes P.L. 87-88. A similar bill had been vetoed by President Eisenhower in 1960.

¹⁷Sundquist, op. cit., chapter VIII.

vetoed bill.¹⁸

The "National Environmental Policy Act," while not limited to the control of water pollution, established a national policy for environmental quality."¹⁹ One important provision of that act was the requirement that all proposed Federal activities that might have a significant effect on the environment must be supported by an environmental impact statement.²⁰ Furthermore, all Federal agencies were directed to "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design acts in planning and in decisionmaking which may have an impact on man's environment."²¹ As a complement to the formulation of a national policy, this act also created the Council on Environmental Quality.

The "Water Quality Improvement Act of 1972" provided for stricter controls over oil pollution, pollution from ships, and pollution from federal activities.²² In October 1972, Congress passed a complete revision of the "Water Pollution

¹⁸Ibid., p. 367.

¹⁹P.L. 91-190.

²⁰Ibid., Sec. 102 (C).

²¹Ibid., Sec. 102 (A).

²²P.L. 91-224. Environmental Quality--1970, p. 44.

Control Act" over a veto by President Nixon.²³ The revised act supercedes the original 1948 act as amended in 1956 and by the "Water Quality Act of 1965," the "Clean Water Restoration Act of 1966," and the "Water Quality Improvement Act of 1970." Title IV of the current statute, "Permits and Licenses," apparently replaces the discharge regulation procedures adopted by the Environmental Protection Agency pursuant to the "Refuse Act of 1899."

Air pollution abatement legislation.--Increasingly troublesome smog problems in Los Angeles during the late 1940's along with the Donora incident in 1948 seem to have triggered Federal efforts for achieving air quality. However, specific Federal air pollution legislation was not enacted until 1955.²⁴ That act provided funds to enable the Public Health Service to engage in research and technical assistance to states and localities.²⁵ Another eight years passed before the first permanent legislation for the control of air pollution, the Clean Air Act of 1963, was adopted. The Clean Air Act established a formal procedure for Federal intervention

²³"Federal Water Pollution Control Act Amendments of 1972," P.L. 92-500.

²⁴P.L. 84-159.

²⁵Environmental Quality--1970, p. 73.

²⁶P.L. 88-206.

in interstate air pollution problems and, upon request from the State concerned, in intrastate problems as well. The long delay in enacting such legislation was due in considerable measure to the fact that air pollution had been widely perceived as a strictly local problem in which few cases of poor air quality were caused by pollution originating outside the affected geographical region.²⁷ The Motor Vehicle Air Pollution Control Act, passed in 1965, authorized the Department of Health, Education, and Welfare to promulgate emission standards for new motor vehicles.²⁸ Davies reports that "the automobile industry did not object strongly, because it feared fifty diverse state standards far more than a uniform Federal Standard."²⁹ Current Federal action in the abatement of air pollution, aside from regulation of motor vehicle discharges, is based largely upon the Air Quality Act passed in 1967. That legislation set forth a method of Federal-State cooperation in developing standards and enforcement plans for air quality regions.³⁰

²⁷Davies, op. cit., p. 51.

²⁸Title II of P.L. 89-272. Title I contains several slight amendments to the Clean Air Act of 1963. Title III is the Solid Waste Act. This description is based on ibid., p. 50.

²⁹Ibid., p. 54.

³⁰Environmental Quality--1970, pp. 73-74.

The "Clean Air Amendments of 1970" authorized the Environmental Protection Agency to develop National Air Quality Standards.³¹ Those amendments also furnished a procedure for the States to develop plans for attaining the national standards within their own boundaries and to submit their plans to the EPA for approval.

Federal efforts to control other forms

of environmental disruption.--Although water pollution and air pollution are widely considered to be the major disruption forms, many other do exist and specific action has been taken by the Federal government to control certain of them. In 1965, the Solid Waste Disposal Act was adopted. This legislation made funds available for research, training, and demonstrations of new technology in solid waste disposal. Included also were grants for state and interstate solid waste planning programs.³² In 1970, the Resource Recovery Act, providing for demonstration grants for the development of solid waste recycling systems, was passed. This legislation also authorized the Environmental Protection Agency to develop guidelines concerning both the construction and the running of solid waste systems either operated by a Federal agency or

³¹P.L. 91-604.

³²P.L. 89-272. Environmental Quality--1970, p. 118.

developed as a Federally-funded demonstration project.³³ A major reason for a restricted Federal role in this area is that

Unlike air and water pollution, which can befoul even distant areas, solid wastes harm only the immediate surrounding area. Thus, solid waste mismanagement primarily affects the area where wastes are dumped and secondarily the community from which they are collected.³⁴

Federal as well as State assistance is required, however, in order to achieve cooperation among localities. Cities face two increasingly troublesome disposal problems: (1) landfill sites are becoming difficult to find and skyrocketing land values often nearly price the available sites beyond a municipality's budget, and (2) given the level of air pollution control now required, the cost of running municipal incinerators has likewise soared.³⁵

Obviously a special problem, the disposal of radioactive wastes had long been regulated by the Atomic Energy Commission. More recently comprehensive authority for the development of plans and environmental standards for all toxic wastes has been vested in the EPA.³⁶

Federal action to control disruption from the introduction

³³42 U.S.C.A. section 3251 et seq. Environmental Quality--1971, p. 16.

³⁴Environmental Quality--1970, p. 119.

³⁵Ibid., p. 120.

³⁶Environmental Quality--1971, pp. 16-17.

of pesticides into the environment began in a meaningful way with the 1954 amendments to the Food, Drug, and Cosmetic Act. These amendments authorized the Food and Drug Administration to determine safe limits for the amounts of pesticides remaining, at the time of sale, in agricultural products to be used as food for humans or animals. The Federal Insecticide, Fungicide, and Rodenticide Act requires all such substances sold in interstate commerce to carry warnings to prevent injury to persons. If labeling cannot assure a substance's safe use, it cannot be sold.³⁷ Although this Act was passed in 1947, it did not become an important device for environmental control until 1971 when a Federal Appeals Court declared that "Congress intended any substantial question of safety to trigger the issuance of cancellation notices," which would prohibit interstate shipment of the substance in question.³⁸ Pursuant to this court decision, the EPA began issuing cancellation notices for a number of pesticides, requiring that hearings be held concerning their safety. Subsequently, Congress passed the "Environmental Pesticide Control Act of 1972" which amends and strengthens the earlier "Federal Insecticide, Fungicide, and Rodenticide Act." In particular, these amendments require the registration of all pesticides, regardless of whether they are used in interstate commerce.³⁹

³⁷Environmental Defense Fund v. Ruckelshaus, 439 F. 2nd 584 (D.C. Cir. 1971). As quoted in ibid., p. 15.

³⁸Environmental Quality--1971, p. 15.

³⁹P.L. 92-516.

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³⁸Environmental Quality--1971, p. 15.

³⁹P.L. 92-516.

Noise pollution is another disruption problem that has been left largely in the hands of State and local governments. The Council on Environmental Quality reports that while non-Federal laws to regulate noise are abundant, they are largely ineffective due to their limited scope or lack of enforcement provisions. "Qualitative" standards, prohibiting noise that is deemed to be "excessive," can generally be enforced only when there are specific complaints from citizens. "Objective" standards, prohibiting noise that exceeds a certain decibel level, appropriately measured, requires expensive equipment and trained personnel for enforcement. Moreover, many technical measurement problems impede such control.⁴⁰ Federal action in this area began in 1969 when the Department of Labor issued standards that set allowable limits for noise pollution affecting workers. Later that year, regulations to control aircraft noise were announced by the Department of Transportation pursuant to provisions contained in Public Law 90-411 which had been passed during the preceding session of Congress.⁴¹ The Department of Housing and Urban Development established in 1971 tolerable noise limits for housing units it helps finance. These rules also serve to prevent HUD from financing buildings in locations which have or are projected to have excessive noise levels.⁴²

⁴⁰Environmental Quality--1972, pp. 208-10.

⁴¹Environmental Quality--1970, p. 129.

⁴²Environmental Quality--1972, p. 133.

The "Noise Control Act of 1972," while stressing the basic role of State and local governments for controlling noise, extends Federal activity in this area.⁴³ Federal agencies which have authority over facilities generating noise are required to establish and enforce noise control standards. Such actions are to be coordinated by the EPA. Moreover, the EPA is instructed to develop regulations concerning the noise levels of the following types of equipment: construction, transportation, electrical or electronic, and all motors.

In addition to the specific laws and administrative procedures described above, the Federal government has sponsored environmental research of a wide-ranging nature. Most of these studies are now supported and supervised by the Environmental Protection Agency.

Reporting requirements under existing legislation.--One conclusion that may readily be drawn from the preceding description of Federal disruption-abatement actions is that the general approach to control depends greatly upon Federal-State cooperation. With some notable exceptions, such as reports on emissions tests of new automobiles and on construction and operation of nuclear-powered electricity generating plants, the Federal government requires very little from individual firms, in the way of environmental reports. Since State governments bear primary responsibilities for implementing

⁴³P.L. 92-574.

programs for attaining environmental quality, most required reports must be filed with State or local agencies. In Michigan, for example, many firms must file an annual "Air Pollution Reporting Form"⁴⁴ and similar reports dealing with water pollution.⁴⁵ At both the Federal and State levels, agencies whose primary area of concern is not pollution, do require various types of environmental reports from specific categories of firms that are under their jurisdiction. Some of these reporting requirements will be discussed in Chapter VII (as they pertain to an electric utility) and in Chapter X (as they pertain to attestation by the independent accountant).

Distinguishing Between the Current, Transitional Period
and the Future, Mature State

In considering his available options, the environmental decisionmaker, either within a government agency or within a private firm, must use considerable foresight. In particular, he must realize that today's situation is one of great flux and that future environmental disruption abatement needs and standards may be quite different from those now in effect. A long-range planning horizon for environmental quality is dictated by two considerations. First, there is substantial lag (or, more accurately, series of lags) between the time an environmental

⁴⁴Michigan Air Pollution Control Commission Form AP-100.

⁴⁵Michigan Water Resources Commission Forms EDF and WRC-5.

problem is recognized and the time when abatement regulations become effective. Most problems require lengthy research and analysis before specific control standards can be formulated: the harmful effects from the disruption must be clearly identified and then quantified, the human costs of the effects must be estimated, and a control strategy must be developed. While lags of this sort obviously affect government decisionmakers in a very direct way, such lags must also be considered by managers of firms. In deciding upon methods of complying with environmental standards, business firms must recognize potential future regulations and incorporate them into the analysis. Emerging areas of environmental concern must be studied so that the approach to compliance taken by the firm will be satisfactory over the long run.

The second consideration necessitating a long-range planning horizon is the fact that many control strategies require intensive capital investment. Once a firm embarks on such a course it may become quite difficult or costly to change either the levels or the types of control being used.

These problems are compounded for decisionmakers operating today because the current situation with respect to environmental disruption is probably different from what will be the situation a few years hence. Differences between the current period and what might be termed the future "mature state" have important implications for both decisionmakers and accountants. In particular, accountants must be careful not to promulgate reporting standards to be used in the future which are based

solely on characteristics of the current situation. Thus, distinctions between today's circumstances and those of the future will now be drawn.

The current period of transition.--The present situation may be characterized as one of transition from primitive controls to comprehensive and intense controls. Prior to the mid-1960's, environmental regulations consisted of a number of rules formulated by various agencies at the Federal, State, and local levels of government. Typically, these rules were developed on an ad hoc basis and, thus, were designed to deal with a specific, and narrow, range of environmental concerns. No overall framework for concerted government or private action was available. As the early part of this chapter shows, the Federal government began to accept a major role in and develop a coherent strategy for the abatement of environmental disruption around 1955. One might view the decade following 1955 as the period of growing acceptance of the Federal role in abatement and starting to develop a national strategy. Similarly, the following decade, of which we are now nearing the end, may be viewed as the period of defining and implementing national environmental strategies. Indeed, 1975 appears to be the target date for full applicability of National Primary and Secondary Standards for air and water pollution.

What are the distinguishing characteristics of this current, transitional era? First, environmental decisionmakers at all levels now face large uncertainties such as those

concerning the natures of disruption problems, the physical size and social importance of costs and benefits pertaining to abatement, and the effectiveness of certain control techniques. Second, the trend toward acceptance, by American corporations in general, of some degree of "social responsibility" represents either a new or a greatly-expanded goal or constraint for the business manager. Third, government agencies are experiencing considerable problems in administering their regulations. Often, these agencies are understaffed, reporting techniques are inadequate (and audits are infrequent or non-existent), and inspection and evaluation methodologies are rudimentary. Fourth, many of the disruption controls that have been installed to date represent modifications to existing buildings and equipment.

The future: a "mature state."--In contrast to the uncertainties and rapid changes of the current period, the years following 1975 will witness the gradual maturation of environmental controls. During this future era, decisionmaking will be quite different from that at present. With the availability of a large data base reflecting actual experience, less uncertainty will surround the analysis of new disruption forms and new abatement techniques. Moreover, after an initial period of "refining"--by government agencies and the Congress--environmental goals and standards, corporate decisionmakers should face fewer abrupt changes in regulations. The enlarged data base combined with a relatively-stable regulatory framework will permit environmental decisionmaking to be far more orderly

a few years hence than it has been in the recent past.

Increased production costs from abatement equipment or effluent charges or both will have resulted in the closing of marginal plants. In its 1972 report, the Council on Environmental Quality summarized several microeconomic studies of major industries. These reports contain projections of future cost increases due to environmental controls and the microeconomic impact of such cost increases.⁴⁶ The Council concludes that "the long-run viability of no industry is seriously threatened solely by the pollution abatement costs estimated."⁴⁷ Those plants that remain will be larger, newer, and more efficient than those that will have been forced to close. (One tentative inference which may be drawn from all this is that there will likely be increased barriers to entry into these industries. The resulting costs in terms of an increased degree of monopoly or oligopoly cannot be reasonably estimated and appear not to have been considered by the Council.)

New plants which will be built will be designed and constructed with ecology specifically in mind. Hence, abatement equipment and methods will generally be built-in rather than added-on. As a result, it often will be nearly impossible to separate out the cost of pollution abatement activities other than by using some arbitrary, and therefore useless for

⁴⁶Environmental Quality--1972, pp. 287-301.

⁴⁷Ibid., p. 287.

decisionmaking, basis of allocation.⁴⁸ This situation corresponds precisely to present circumstances in which, for example, the cost of providing for the safety of workers often cannot be separated from plant and equipment costs. Just as it may now be impossible to purchase a circular saw without a blade guard or safety clutch, so it may become impossible in the future to obtain a blast furnace with no pollution controls. The abatement equipment will be incorporated in the basic design of an improved modern model. The unavailability of specific cost information should pose no substantial problem, however, since the cost of environmental disruption will have become largely internalized, that is, borne by the disrupter.

Despite the differences examined above, the need to continue to improve the administration of standards is a problem that will surely carry over from the current era into the future steady state. Again, the availability of a large, historical data base, provided that it is managed adequately and used effectively, will make it possible to refine overall environmental standards, discover lower-cost solutions for achieving them, and improve both the economic efficiency and the equity of disruption controls.

In order to develop a conceptual framework for discussing environmental decisions, this chapter has examined the development of abatement regulations, reporting requirements under those regulations, and the differences between the current, transitional

⁴⁸See Environmental Quality--1973, p. 89, for an example of this difficulty.

era and the future, "mature state." In the next chapter, the economic aspects of disruption and its control will be inspected from a theoretical viewpoint.

III. THE ECONOMIC FRAMEWORK

This and the next two chapters will be devoted to environmental decisions made by government agencies. The direct purpose of this discussion is the specification of information needed by government agencies to formulate, implement, and administer remedies for disruption. The indirect, although equally important, purpose is the demarcation of the context within which decisions must be made by firms and individuals. Since a particular decision cannot be scrutinized meaningfully unless its constraining parameters are specified, it is necessary to examine decisions of government agencies before those of firms and individuals.

In this chapter, the economic framework germane to the environmental decisions of governmental agencies will be reviewed. Theoretical economic models drawn from the recent literature will be presented to furnish (1) a foundation for discussing economic aspects of disruption and its control, (2) a basis for forecasting the effectiveness and efficiency of different regulation strategies, and (3) a concrete methodology for evaluating individual factors under benefit-cost analysis--the basic method by which government agencies can select among alternative environmental proposals. (The information required as inputs to these models will be delineated in the next chapter, following a detailed inspection of the

benefit-cost model.) After the presentation of these specific models, the practicalities of the "real world" decision setting will be analyzed: what are the economic, political, and social constraints that affect which remedies will be applied to whom and by whom? This analysis will consist of an interpretive review of the relevant public finance literature.

Economic Theories of Environmental Disruption

When the environmental disruption problems and possible remedies mentioned in Chapter I are investigated in order to develop the most effective solutions, two serious conceptual obstacles appear. Both of these stem from the interrelationships among various types of disruption and their means of control. The first obstacle is the condition where the control of one type of disruption leads to a change in the amount of another type. It may be illustrated by a situation where certain harmful particulates are emitted from the smokestack of a manufacturing plant. One possible way to reduce such emissions might be to "wash" the smoke in some way. While such a method might well reduce air pollution, it will also increase water pollution. Similar interdependencies pervade disruption abatement technology.

The second obstacle is the need to decide the extent to which each particular type of disruption (and each specific kind of source for each type) is to be reduced. For example, suppose that in addition to being emitted from smokestacks, the harmful particulates referred to in the previous illustration

are also present in the exhaust from automobiles. In this setting, some decision must be reached as to the appropriate level of control for each source. Although it seems ridiculous to attempt to restrict particulates from smokestacks completely while ignoring those discharged by automobiles, the alternative which consists of attempting to apply the same level of control to each source may be neither feasible nor desirable. No other specific solution is obvious. This difficulty becomes even more bothersome when additional harmful substances are considered simultaneously. The control level for particulates cannot be considered separate from the control levels for other pollutants, such as nitric oxides and hydrocarbons, which are also present in smokestacks and exhaust pipes.

These interrelationships present compelling reasons for establishing a broad model for studying remedies for environmental disruption. Without such a framework, truly adequate decisionmaking is impossible. Many control measures which have already been implemented have been developed on an ad hoc basis, that is, solutions to specific problems have been adopted without sufficient consideration of them within a general framework.¹ As more regulations are designed, it will become increasingly necessary to base them upon a theoretically-sound model of

¹ Although economists seem to have a disdain for non-optimal solutions and rightfully point out the fallacies of "second-best," an optimality fixation would be irrelevant here: Use of the ad hoc procedure, currently and in the recent past, may be justified on two grounds. First, resolution of environmental disruption problems has been so urgent that some steps were required, even before a general approach could be developed. Second, partial abatement of the most damaging sorts of disruption would almost certainly have been decided upon if a theoretically optional approach had been used.

environmental disruption. Intuitive approaches, or those derived within the context of a narrow framework will not suffice.

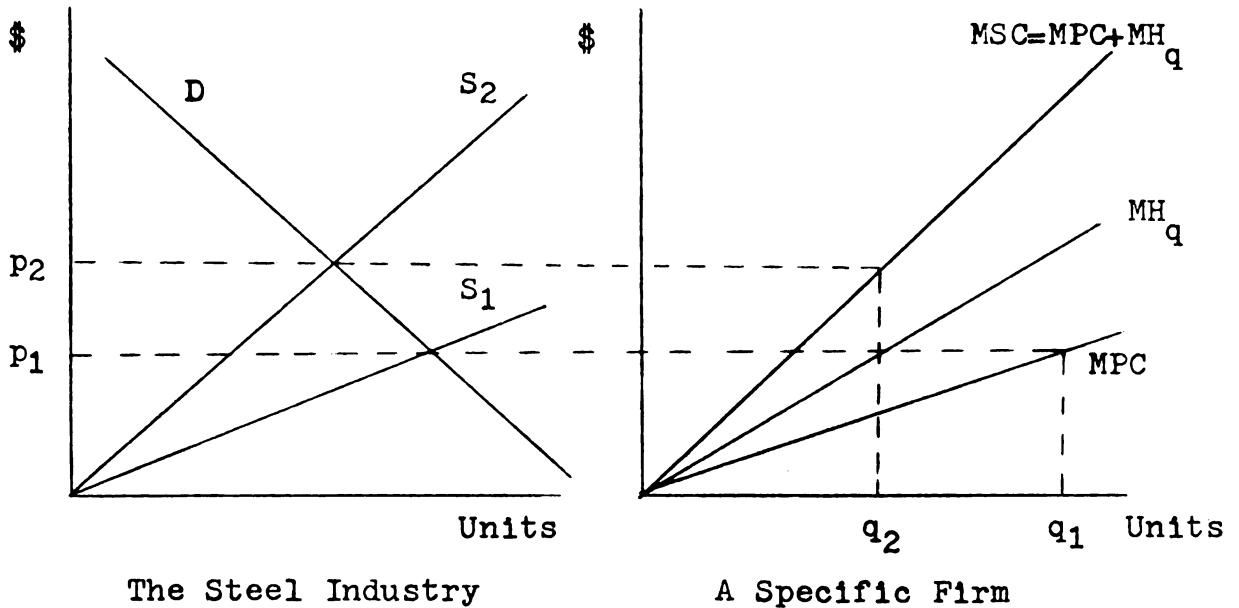
Some approaches toward structuring a model for the control of environmental disruption which have appeared in the economic literature will be discussed in the following pages.

The Static Microeconomic Approach

Economists generally regard environmental disruption problems as a special case of economic externalities. An economic externality occurs when one individual's production or consumption has an unintended or incidental impact on another individual's production or consumption. This "spillover" effect may benefit others (an external economy), as when landscaping done by one homeowner adds to the attractiveness of the neighborhood as a whole. Conversely, the "spillover" effect may harm others (an external diseconomy), as when a steel plant emits particulates into the air, thus creating soiling and health problems for nearby residents. In the presence of an economic externality the "private" cost borne by the original producer or consumer diverges from the total "social" cost borne by society as a whole.²

²On occasion, the term "social cost" is used rather loosely. As stated above, the social cost of producing an item, for example, includes both the private costs to the producer plus any additional costs borne by other members of society. "Social cost" is not synonymous with "cost not borne by the producer" or "external cost". Thus if social costs are added to private costs, these private costs will be double-counted.

For instance, the manufacturing costs incurred by the steel company in the example above do not include the costs of the neighbors' sufferings. From society's viewpoint, steel is underpriced. This situation is illustrated, for a purely competitive steel industry, in the following graphs:



These graphs are drawn in the usual way, with dollars per unit of steel shown on the vertical axis and the quantity of steel on the horizontal axis. D represents the demand for bricks. Under purely competitive conditions, S_1 represents the existing supply of steel, while S_2 represents the supply which would exist if the externality were internalized, that is, if the supply were based upon total social cost. MPC is the marginal private cost of producing steel, MH_q is the marginal amount of harm done to other members of society by the production of steel, and MSC is the total cost to society of producing steel. The equilibrium price and quantity for steel produced by a

specific firm are designated p_1 and q_1 respectively. If for some reason pollution abatement is not possible, then p_2 and q_2 represent the optimal price and quantity, from society's viewpoint.³

Closely related to the concept of economic externalities is the notion of collective consumption goods. Samuelson describes these as goods "which all enjoy in common in the sense that each individual's consumption of such a good leads to no subtraction from any other individual's consumption of that good."⁴ Furthermore, there is no way to exclude anyone from the consumption of such a good. Thus, if each individual is to be taxed according to his stated desires, he will be inclined to understate his preference for a good of this type. He will be able to consume all that is available regardless of what he proclaims his wants to be.⁵ From an analytical standpoint society's demand curve for a collective consumption good must be derived by adding individuals' demand curves vertically instead of horizontally as would be done with non-collective

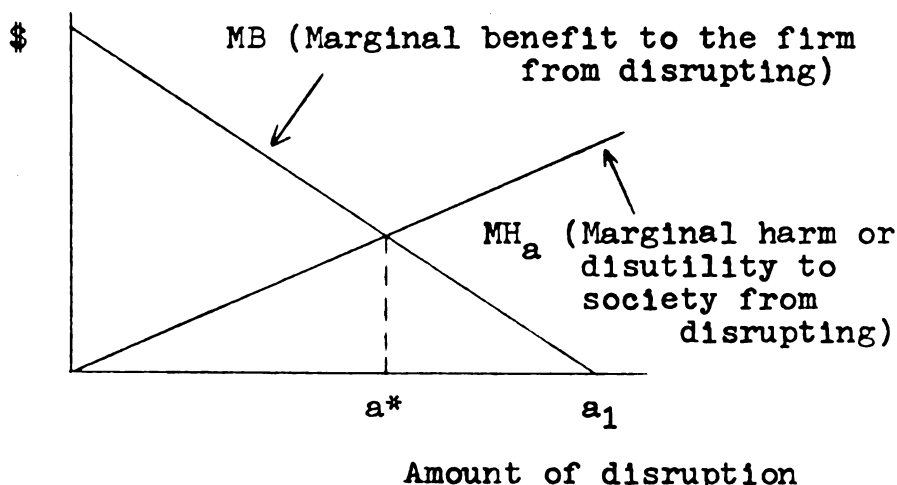
³More realistically, if the firm is forced to abate some of its pollution, the MPC curve will move upward. At the same time, the MH_q curve will shift downward since other individuals will not be harmed as much as they had been. When the firm is abating that amount of pollution which will cause the MSC curve to drop to its lowest level, then it will be producing the optimal number of bricks from society's viewpoint. That number will be somewhere between q_1 and q_2 . This analysis assumes, of course, that all other conditions for Pareto optimality are fulfilled.

⁴Paul A. Samuelson, "The Pure Theory of Public Expenditure," The Review of Economics and Statistics, XXXVI, No. 4 (November, 1954) p. 387.

⁵Ibid., pp. 388-89.

goods. This type of analysis is relevant to environmental decisions since disruption abatement may be considered as a collective consumption good.

To apply these concepts more precisely to environmental disruption problems, several authors have used a structure similar to that shown in the following graph:⁶



Under certain general assumptions the "Pareto-optimal" amount of environmental disruption is a^* , corresponding to the point at which the marginal benefit and the marginal harm are equal.⁷ The MB curve may be viewed as the demand for the "right

⁶For instance, see Allen V. Kneese, "Rationalizing Decisions in the Quality Management of Water Supply in Urban-Industrial Areas," in The Public Economy of Urban Communities, ed. by Julius Margolis (Baltimore: Johns Hopkins Press, 1965).

⁷An economic state is said to be "Pareto-optimal" if no increase in any consumer's utility or any producer's profit may be obtained without a concomitant decrease in at least one other party's utility or profit. See, for example, Josef Hadar, Elementary Theory of Economic Behavior (Reading, Mass: Addison-Wesley, 1966), pp. 280-81. The concept of "Pareto-optimality" ignores income distribution.

to disrupt," while the MH_a curve may be interpreted as the supply. Since at the present time, however, few legal "rights to disrupt" have been clearly established, the true supply curve is often a vertical line representing the maximum amount of disruption physically possible. This line probably lies so far to the right of point a^* in the diagram above that it does not even intersect the MB curve. In this case, the firm disrupts until there is no marginal benefit from doing so (at point a_1); from the firm's viewpoint, the "right to disrupt" is a free good.⁸

Under this approach, the solution to environmental disruption problems consists of making the firm reduce its disruption from a_1 to a^* . For instance, an ad valorem tax equal to MH_a may be imposed, thus causing the external diseconomy to become "internalized," that is, borne by the firm. In order to implement such a strategy, the government decisionmaker must know the location of the MH_a curve. In addition, the private firm must know the position of its MB curve.

Aggregative Approaches

While the model described above seems to be valuable

⁸The role of laws regarding property rights and liability for damages caused by disruption has received considerable interest by economists interested in economic externalities. Property rights are examined closely in J. H. Dales, Pollution, Property, and Prices (Toronto: University of Toronto Press, 1968). Legal liability is discussed in a famous article by R. H. Coase, "The Problem of Social Cost," Journal of Law and Economics, Vol. 3, No. 2 (October 1960), pp. 1-44.

for analyzing environmental disruption with respect to individual consumers, producers, or industries, it--or any other micro-economic model, for that matter--ignores macroeconomic consequences of disruption and abatement such as changes in the general price level, unemployment, consumption, investment, government spending, and income distribution. Thus, a strictly microeconomic approach is an inadequate basis for developing national (and global) strategies for protecting the environment. While many macroeconomic models have been suggested as foundations for environmental analyses, three of them appear to be especially useful and will accordingly be described below.

The "disproduct" approach.--The first of these macro models centers about the notion that Net National Product, as it is now formulated, ignores the environmental deterioration that accompanies economic activity and therefore overstates the value of the goods and services produced. Accordingly, misleading inferences about changes in economic welfare might be drawn from NNP statistics. Recommendations have been made for the calculating of a more meaningful "measure of economic welfare" by adjusting NNP for such disamenities as pollution and by making certain other modifications.⁹ This concept of MEW (Measure of Economic Welfare) could become embodied in the conventional macroeconomic framework just as GNP has been.

⁹Kenneth Stewart, "National Income Accounting and Economic Welfare: The Concepts of GNP and MEW," Federal Reserve Bank of St. Louis Review, April 1974, pp. 18-24.

The "input-output" approach.--Another aggregative model which may prove useful for investigating environmental problems consists of an extension of the familiar Leontief input-output analysis.¹⁰ Under this approach, the national economy is subdivided two ways: (1) "input sectors" which comprise productive industries, pollution released by the productive processes, and labor¹¹; and (2) "output sectors" which comprise productive industries, pollution abatement industries, and households (which are also referred to as the "final demand" sector). This analysis centers around "technical coefficients," that is, the number of units required from each of the "input sectors" in order to produce one unit in each of the "output sectors," other than households. Within this framework, once a list of final demands by households has been established, the required output in each of the other sectors is determined. Relative prices of all goods produced as well as employment in all sectors may also be derived from the analysis. A sample input-output system is described in the appendix to this chapter.

The literature on Leontief input-output systems is quite extensive; the simple model developed in the appendix may be extended in many different ways such as constructing a

¹⁰Wassily Leontief, "Environmental Repercussions and the Economic Structure: An Input-Output Approach," The Review of Economics and Statistics, LII, No. 3 (August, 1970), pp. 262-71.

¹¹To be more precise, labor should be replaced by "value-added," that is, all production costs other than inputs from other productive industries or pollution. See ibid., p. 265.

a dynamic model or including the possibility of partial abatement of disruption by the productive industry itself.¹²

The "materials-balance" approach.--The final model to be considered here has been developed largely by Allen V. Kneese and his associates at Resources for the Future.¹³ This approach is based upon the physical "law of conservation of mass, which states that in a chemical changes mass is neither created nor destroyed to any appreciable extent."¹⁴

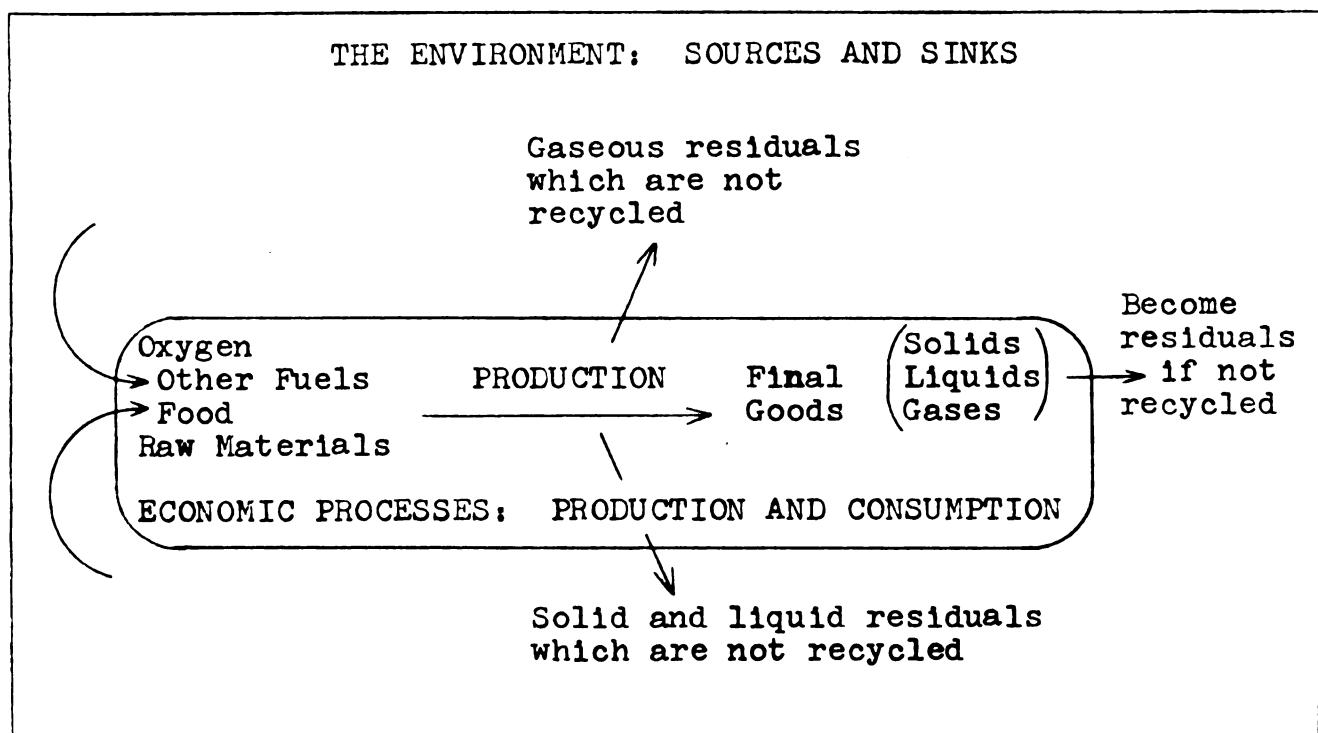
¹²It is interesting to note that the Leontief model may be useful in an additional way. To the extent that accounting draws upon economic theory, it uses analysis that comes from microeconomics rather than macroeconomics. Ironically, the "hot" branch of economic theory today seems to be macroeconomics. In principle, at least, the input-output analysis could be disaggregated to the point where individual firms rather than industries could be inspected. Within such a structure, financial data about individual firms--data developed by accountants--could be used directly as inputs to an analytical, macroeconomic model. In this way, economists might make greater use of accountants' work, while accounting theory might further utilize economic theory. This dissertation, in particular, includes but one possible application of such economic theory.

Some applications of input-output analysis have appeared in the accounting literature. For a restatement of the inter-industry model, for example, see Charnes, A. et al., "Economic Social and Enterprise Accounting and Mathematical Models," The Accounting Review, January, 1972, pp. 87-92. Similar analysis has been applied to the study of individual firms.

¹³Robert U. Ayres and Allen V. Kneese, "Production, Consumption, and Externalities," The American Economic Review, LIX, No. 3 (June, 1969), pp. 282-97. Allen V. Kneese and Ralph C. d'Arge, "Pervasive External Costs and the Response of Society," in Subcommittee on Economy in Government of the Joint Economic Committee, The Analysis and Evaluation of Public Expenditures: The PPB System, Vol. I (Washington: U. S. Government Printing Office, 1969), pp. 87-115.

¹⁴Michell J. Sienko and Robert A. Plane, Chemistry, 3rd Ed. (New York: McGraw-Hill, 1966), p. 22.

As a result, the amount of wastes produced by the economy which require disposal is virtually equal to the amount of material inputs to production, ignoring any investment. These wastes must either be recycled as inputs to the production process, or they must be assimilated by "sinks" in the environment. While these environmental sinks are capable of absorbing moderate quantities of most wastes without exhibiting significant signs of deterioration, they are becoming increasingly



A Materials-Balance View of the Economy¹⁵

¹⁵ Adapted from a chart appearing in Kneese and d'Arge, op. cit., p. 90.

overstrained by the operations of advanced economies.

Under this approach, environmental disruption is treated not as an aberration of normal economic processes, but rather as a fundamental part of them. A schematic view of the economy, consistent with materials-balance thinking, is shown in the diagram on the previous page.

The formal materials-balance model closely resembles the Leontief input-output model which was described in the previous section (and which is illustrated in the appendix to this chapter). Again, the "technical coefficients" of various production processes are the building blocks of the framework. This specific theory has been introduced, however, because of its central emphasis on the interrelationships between the economy and the environment.

Constraints Involved in Implementing the Models

The models presented above represent generalized and abstract ways to view the real world. While they may serve as useful guides or short-cuts, by themselves they cannot provide a sufficient understanding of the nature of specific and real environmental decisions. Considerable attention must also be paid to the explicit and implicit assumptions underlying such economic models and to the complexities inherent in most actual decisionmaking situations. For to remain tied to theoretical models is to invite the possibility of reaching irrelevant or erroneous conclusions as conditions vary from those implied

by the models. In order to provide an adequately-broad perspective for the study of complex environmental decisions and their informational requirements, the constraints which shape and condition the decisionmaking process must be carefully analyzed. These constraints fall into three broad groups which will be discussed below: economic, social and political.

Economic Constraints

Often the limiting assumptions pertaining to economic models, such as the ones described earlier, are made quite explicit. With distressing frequency, however, certain assumptions are either unstated or forgotten. While the list presented below is not exhaustive, it includes those assumptions that are particularly relevant to the economic models described above and that seem especially critical for the purposes of this paper.

Interaction of environmental actions with other economic goals.--Most of the economic models which have been proposed for the study of environmental disruption and its control have been cast in the context of partial equilibrium analysis. As a result, the impact that environmental actions have on the five public finance functions are ignored in these formulations. These public finance functions consist of (1) allocation of social goods and services (pollution-abatement is but one), (2) provision of an acceptable distribution of income, (3) economic stabilization, (4) economic growth, and (5) control of the balance of payments

situation. Conversely, action to influence any of these public finance functions influences the environmental function. In the real world, decisions affecting all of these functions are made concurrently; other things do not remain constant!

The conceptual and methodological difficulties present in analyzing only a limited portion of such a network of interdependencies are examined by Churchman:

There is a fundamental limitation of any modeling of a system, that the system is always embedded in a larger system Consequently, no matter how marvelously a specific system works, in terms of a larger system it may not "work" at all. In sum, the true costs associated with any system always reflect the way in which the larger system behaves.¹⁶

As regards environmental decisionmaking, the true costs and benefits of public programs for abatement can only be measured after considering the entire socio-economic system. Hence, the obvious course of action would seem to be studying the larger system in detail. Yet, Churchman goes on to explain that

. . . As one moves to consideration of larger, and larger systems, the problems of complexity become enormous. This can be seen most clearly in the case of the measure of performance of a system In general, we can say that the larger the system becomes, the more the parts interact, the more difficult it is to understand environmental [in the sense of being "outside" the system rather than in the "ecological" sense] constraints, the more obscure becomes the problem of what resources should be made available, and, deepest of all, the more difficult becomes the problem of the legitimate values of the system.¹⁷

¹⁶C. West Churchman, The Systems Approach (New York: Dell Publishing Co., 1968), pp. 75-76.

¹⁷Ibid., pp. 76-77.

Churchman's observations pointedly demonstrate the impropriety of implementing a decision strategy based specifically and precisely upon one of the economic models presented in Chapter III. However, questions of public policy must be resolved, the decisionmaker must follow through as best he can. A "pragmatic" approach that is consistent with the general spirit of the economic models will be described in the next chapter. Such a crude, approximate, but practicable method will be the basis for the analysis to be developed later in this dissertation. But caution remains in order: The interactions discussed above still constitute a limiting factor on the analysis.

Definitional problems.--Although a definition for environmental disruption was put forth in Chapter I, it was intended to be a tentative, working description. In particular, that definition contained at least three phrases which themselves require further definition. Two of these, "stress" and "stable ecological system" can be taken to be technical terms properly left within the realm of the physical scientist.¹⁸ For present purposes, the reader's intuitive understanding of these phrases should be adequate; in this analysis they will be considered to be "primitive terms." However, the phrase "deleterious effects on humans" is one that a social scientist cannot avoid

¹⁸Many physical scientists no doubt would consider all ecological systems to be constantly in flux, moving towards a new equilibrium in response to stress, but experiencing a new stress before any equilibrium can be attained. This writer, while acknowledging the importance of these physical science considerations to the study of environmental disruption, feels that they go beyond the scope of this paper. Again, an appeal is made to the intuition of the reader.

cannot avoid inspecting. What is meant by an effect that is deleterious? Whose values should be applied in deciding whether a particular effect should be considered to be deleterious? While no precise answers to such questions are possible, it may be observed that two sorts of decisions must be made. The first is a "technical" decision as exemplified by a physician determining that smog is injurious to human health. The second sort of decision is inherently subjective in that it depends upon the perceptions and values of individuals. What one person may consider deleterious, another might consider harmless or even beneficial. As a result, it is impossible to identify all pollution problems: in a sense whether a particular occurrence can be considered to be a form of environmental disruption depends upon the collective tastes of society at any point in time. Certain environmental changes, which are taking place today but are not considered to be disruptive, may be viewed as definitely harmful at some future date. These considerations, relevant to most economic analysis, are of particular concern with respect to environmental disruption and its abatement, for the analysis of this subject must be dynamic and long-range. The set of all forms of recognized disruption will not remain unchanged over time.

Distribution of income.--As is quite often true in economic analyses, models of environmental disruption, such as those presented in Chapter III, take the currently-existing distribution of income to be given. Since there is no

objective way to determine the "optimal" distribution of income, there is little cause to believe that the present distribution is at all "optimal." Under an alternative distribution of income, several variables in the models, particularly the set of "prices" reflecting society's collective preferences, could conceivably assume values that are drastically different from those under the existing distribution. Accordingly, the appropriate abatement strategies and standards might also be far different. These considerations indicate a crucial need to perform some type of sensitivity analysis on the economic models in order to identify control strategies which would remain nearly optimal under various distributions of income.

As mentioned previously, the national distribution of income is one of the public finance functions that interacts with environmental decisionmaking. At this point, an example of the impact of such an interaction will be presented.¹⁹ Referring to the graph appearing on page 50, the curve representing the marginal disutility to society from environmental disruption is based upon, among many other things, the size of the "social scaling factors" in existence at any point in time. These factors in turn, presumably depend upon the distribution of income (and wealth) among members of society. For the moment assume that there are but two control strategies possible:

¹⁹This example is based on a portion of a presentation made by Professor Colin Wright at a colloquium held at Michigan State University in 1971.

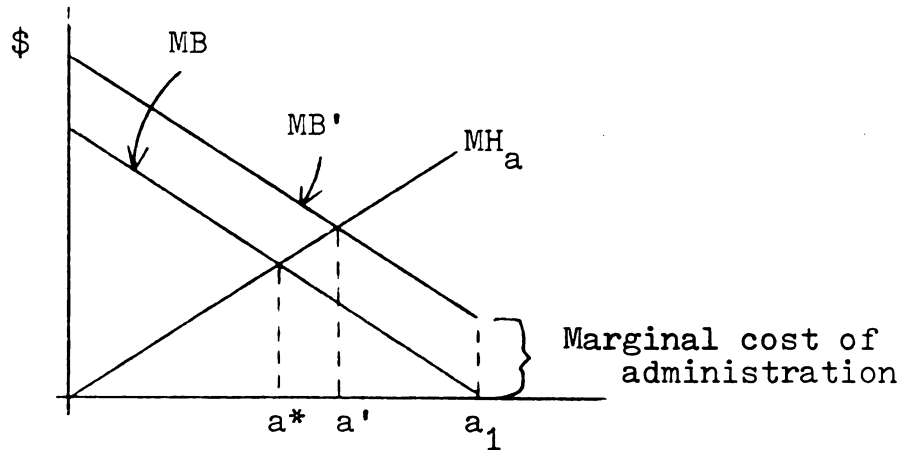
- (1) Impose an ad valorem tax equal to MH_a on the manufacturer.
- (2) Provide an ad valorem subsidy equal to MH_a to the manufacturer for abating his disruption. Finance the subsidy by a general increase in personal income taxes.

While either of the above approaches would appear to induce the manufacturer to point a^* , that "point" will move about because the position of the MH curve will change as the distribution of income changes. Under plan (1), income will be redistributed from the manufacturer to individuals. Under plan (2), income will be redistributed among individuals, since no person is likely to be taxed to the exact amount of his gain in utility from disruption control. Point a^* is therefore a "moving target."

Transaction costs.--Similar to the case of income distribution, the importance of transaction costs to environmental decision-making is typically assumed away in the economic models presented earlier. As pointed out by Dolan, transaction costs may in fact be highly significant in the abatement of environmental disruption.²⁰ These costs may be particularly large in the case of non-governmental, group action, such as action by consumer groups. Furthermore, in all cases of governmentally-supervised abatement, the administrative costs of formulating regulations and checking on compliance

²⁰ Edwin G. Dolan, Tanstanfl*: The Economic Strategy

are probably sizeable. As a result of the existence of these transaction costs, the graph presented on page 50 should be redrawn as follows:



The MB' curve is the sum of the marginal private cost of control (to the firm) plus the marginal cost of administration (to the government). The point a' represents an optimum for the existing structure of administrative costs. While the graph above depicts a constant marginal cost of administration, a variable marginal cost might be more realistic. However, the graph would not look much different for this latter case, and the general conclusions from the analysis would be unchanged.

Shifts in tastes.--A third factor which is "held constant" in the economic models is the set of individuals' tastes or preferences. In fact, tastes frequently do change and often by a considerable degree. The optimal solution

for Environmental Crisis (New York: Holt, Rinehart and Winston, 1971).

could potentially shift drastically as a result. These shifts in personal tastes fall into two categories. First, such shifts may be related to specific economic variables; the possibility of changes in the distribution of income inducing shifts in tastes was alluded to in the preceding section. Similar shifts may be occasioned by a change in the structure of prices. These "economically-induced" shifts can be subsumed under the general problem of interactions among environmental and other economic goals.

A second group of shifts in tastes result from changes in "non-economic" factors. For instance, individuals may become increasingly alarmed over medical studies documenting the effects of air pollution on human health. Thus they demand cleaner air. While such shifts are considered to be "autonomous" from the standpoint of a particular economic model, they must be considered as an important "endogenous" variable within the decisionmaker's decision model.

Social Constraints

Another group of constraints are those which follow from values generally held by society's members. Obviously, a decisionmaker may find certain alternatives morally or ethically infeasible because their implementation would run counter to strong social attitudes. The first three social constraints are often mentioned in the public finance literature. First applied to taxation, these ideas have also been extended to the analysis of government expenditures. Note,

however, that they represent a "normative" (what should be) rather than a "positive" (what actually exists) economic viewpoint. Accordingly, these concepts are usually taken to be "given" in public finance analysis.

Horizontal equity.--Persons in the same general circumstances should be treated equally by the law (or by government in general). A typical example of the doctrine would be a condition wherein persons earning the same amount of income, regardless of its source, would pay the same amount of federal income taxes. In the case of environmental disruption, this concept would be manifest in a situation where all polluters of a given sort would be subject to the same regulatory standards.²¹

Vertical equity.--The costs of financing government activities (and the benefits received from those activities) should be shared by citizens according to their ability to pay (or their need to receive). For example, the federal income tax rate increases as the amount of income an individual earns

²¹Note that there is considerable ambiguity in the application of any of these concepts. For example, suppose that there are two manufacturing plants emitting sulfur dioxide. The plants produce different products and have vastly differing production processes. As a result of this varying technology, it costs one plant twice as much to cut SO₂ emission as it costs the other plant. Assume that each plant is emitting SO₂ at the same rate. Does horizontal equity dictate that each reduce its SO₂ emission by the same percent? Or does this doctrine mean that each plant should spend the same amount on SO₂ emission abatement?

risers. Although the general principle is widely accepted, the degree of progressivity which exists or should exist is a hotly-contested socio-political issue. In terms of environmental disruption, this doctrine may be restated as follows: the burden of abatement should be distributed among members of society according to each individual's ability to pay.

Laissez faire.--Unnecessary governmental intervention in the lives of individuals and in the business sphere should be avoided. Some public finance experts dislike this term, but virtually all agree that some activities belong in the private sector and some must be handled by government. The proper relative sizes of the public and private sectors are continually debated in the literature, however.²²

Consumerism.--While the concepts mentioned above are often mentioned in public finance literature, two additional social constraints seem worth discussing. The first of these is popularly termed consumerism. The central notion here is that individual consumers are often at the mercy of large business corporations and need collective or governmental action on their behalf. Consumer activism appears to be a growing and secular trend in our society. Galbraith among

²²Long a cliché among political conservatives, laissez faire has been re-espoused by political liberals (and radicals!) as well during the past several years.

others, discusses "countervailing power" of large organizations representing different interests in the economy.²³ The doctrine of consumerism certainly is consistent with, if not fundamental to, our "new industrial state."

Political Constraints

This final group of constraints bearing upon environmental decisionmaking includes those inhibitions to implementing policies which are inherent in the operations of our political institutions. Although these have generally been recognized by public finance experts, these constraints are quite distinct from those mentioned above.

Election pressures.--Grouped under this umbrella-like heading are all of the factors weighing on a legislator which lead him to make decisions which are not consistent with, for example, a well-developed economic model for the abatement of environmental disruption. Legislators generally are concerned with potential voter support or may face a manifest need to serve the best interests of their own constituents rather than those of society as a whole. In the case of environmental disruption, as in the case of many other public concerns, such a restrictive viewpoint can lead to poor decision-making.

²³Countervailing power is a concept that pervades many of the writings of John Kenneth Galbraith. See, for instance, The New Industrial State (Second Edition; Boston: Houghton Mifflin, 1971).

Legislators often become fully cognizant only of the view of large special interest groups that can support concerted lobbying efforts. Finally, as election day approaches, votes designed to win the electorate's immediate favor become widespread. For example, social security (OASDHI) benefits are increased with astounding regularity prior to U. S. Congressional elections. The cumulative impact of all these "election pressures" is to constrain the alternatives within a range of political acceptability.

Cumbersome legislative and judicial processes.--The length of time and amount of effort required for passage of an important but controversial bill in the U. S. Congress or in a state legislature are substantial. Furthermore, the congressional budget process has two large shortcomings. One, the process is fragmented in that "each revenue and expenditure item is considered separately without regard to its impact on overall totals in the budget and therefore on the economy."²⁴ Two, the lateness with which Congress typically makes budgetary decisions often precludes it from making meaningful modifications to the budget.²⁵

The pace of the judicial process can also be exceedingly

²⁴Barry M. Blackman, Edward M. Gramlich, and Robert W. Hartman, Setting National Priorities: The 1975 Budget (Washington: The Brookings Institution, 1974), p. 264.

²⁵Ibid., pp. 264-65.

slow in many instances. It may take years before a final decision is reached concerning abatement enforcement, constitutionality of laws, government authority, or legal liability. The current case involving the taconite ~~tailings~~ being discharged into Lake Superior by the plant of Reserve Mining is just one example. While it has been alleged that the tailings contain particles that could cause cancer, ~~legal~~ action has dragged on, causing great uncertainty for all parties concerned.²⁶ Although, such slow deliberation may be a beneficial aspect of our legal system, it is certainly a complication for environmental decisionmakers.

Infeasibility of ordering all of society's goals.--This final political constraint is, in many ways, an outgrowth of all other inhibitions to affecting "optimal" environmental control policy. However, since it bears so heavily on governmental decisionmaking, this difficulty requires special emphasis. Fundamentally, the problem is twofold. In order to rank all of society's goals, each goal must be articulated. Then, some method of comparing the various goals must be established. Neither of these tasks is very likely to be accomplished. Hence, optimal solutions, in the unconstrained sense, can be achieved only by chance and their presence cannot be identified. This conclusion is neither unusual nor surprising. What may be more

²⁶ "Furor Over a Plant on Lake Superior Is Warning to Industry," Wall Street Journal, August 26, 1974, p. 1.

exasperating is the fact that, due to all of the interrelations and uncertainties present in situations calling for "social" decisionmaking, constrained optima are virtually impossible to spot as well. For example, assume that a local government receives a \$10,000 federal grant subject to the provision that it must be used to hire (1) an additional policeman (2) an additional teacher, or (3) an additional pollution control device for the city incinerator. No objective method is likely to be available for measuring the relative social benefits from each of these projects, assuming all three are needed. Because such decisions are thus often highly subjective, there is no real way to determine whether they are optimal.

Using Economic Models: A Reassessment

After considering all of the economic, social, and political constraints discussed above, a natural question is whether any model can really be useful for economic analysis. The answer would seem to be a cautious "yes." For the economic models presented at the beginning of this chapter do provide a framework for thinking about environmental decisions. Such decisions seem inherently economic since benefits and costs are generally translated into dollar amounts in order that the net social benefit of an environmental proposal may be calculated. By providing a basis for predicting the efficiency and effectiveness of alternate strategies for attaining environmental quality and by furnishing a means of evaluating individual costs

and benefits, the economic models represent an indispensable part of governmental decisionmaking. Yet, the decisionmaker **must** constantly remember the various constraints that serve to restrict the options available to him.

This material concerning economic models and their related constraints has served to describe, in a general way, the nature of the environmental decisions made by government agencies. In the next chapter, a closer look will be taken at benefit-cost analysis which is the essential method by which such agencies may choose from alternative environmental proposals. Afterward, a specification will be made of the informational inputs required for benefit-cost analysis and the applications of the economic models presented above.

Appendix: A Sample Input-Output System²⁷

Suppose there is a simple economy which is divided as follows:

<u>Input Sectors</u>	<u>Output Sectors</u>
(1) Agriculture	(1) Agriculture
(2) Manufacturing	(2) Manufacturing
(3) Pollution	(3) Pollution Abatement
(4) Labor	(4) Households

Suppose further that the list of final demands by households include y_1 units of the agricultural product (call it "wheat"), y_2 units of the manufacturing product (call it "cloth"), and y_3 units of pollution. While y_1 and y_2 may be viewed as quantities desired by households, y_3 must be interpreted as the amount of pollution tolerated by households.²⁸ Finally, there is a set of "technical coefficients" for this economy which is displayed in the following table:

<u>From</u>	<u>Into:</u>	<u>Agriculture</u>	<u>Manufacturing</u>	<u>Pollution Abatement</u>
Agriculture		a_{11}	a_{12}	a_{13}
Manufacturing		a_{21}	a_{22}	a_{23}
Pollution		a_{31}	a_{32}	a_{33}
Labor		l_1	l_2	l_3

²⁷This example is based primarily on Leontief, op. cit.

²⁸Ibid., p. 267.

Under these circumstances, the total production of wheat (x_1) equals the sum of the quantity of wheat delivered to households plus the quantities of wheat used as inputs in the agriculture, manufacturing, and pollution-abatement industries.

This relationship may be written as

$$(a) \quad x_1 = y_1 + a_{11}x_1 + a_{12}x_2 + a_{13}x_3$$

A similar equation may be written for the total production of cloth:

$$(b) \quad x_2 = y_2 + a_{21}x_1 + a_{22}x_2 + a_{23}x_3$$

The quantity of pollution "delivered" to households (x_3) equals the sum of the quantities emitted by the agriculture and manufacturing industries (these are called "inputs" of pollution in this model) less the amount of pollution eliminated by the pollution-abatement industry. Realizing that y_3 (the amount of pollution eliminated) has a negative value, this relationship may be written as

$$(c) \quad x_3 = y_3 + a_{31}x_1 + a_{32}x_2$$

Equations (a), (b), and (c) may be presented in the following matrix form:

$$(d) \quad X = Y + AX$$

$$\text{where } X = \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix}, Y = \begin{pmatrix} y_1 \\ y_2 \\ y_3 \end{pmatrix}, \text{ and } A = \begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix}. \quad \text{In order}$$

to solve equation (d) for X , similar terms may be combined and

then factored to give:

$$(I - A)X = Y$$

where I is the identity matrix. If the matrix $(I - A)$ is non-singular, this solution may be written:

$$(e) \quad X = (I - A)^{-1}Y$$

The total employment in the economy (n) may be calculated as the sum of the amounts of employment in each sector, or:

$$n = l_1x_1 + l_2x_2 + l_3x_3$$

This employment equation has the following matrix form:

$$(f) \quad n = L'X$$

where $L = \begin{pmatrix} l_1 \\ l_2 \\ l_3 \end{pmatrix}$. Finally, prices for all goods in the economy

may be calculated. The unit price of each product equals the sum of the costs of the required inputs. In particular, the price of wheat (p_1) may be calculated as follows:

$$(g) \quad p_1 = a_{11}p_1 + a_{21}p_2 + wl_1$$

where w is the wage rate. Note that in this economy producers do not eliminate any of the pollution which they cause. Hence, pollution costs do not enter into the price equations for their products. Equation (g) and a similar equation for the price of cloth may be combined in the following matrix equation:

$$P_1 = A_1'P_1 + wL_1$$

where $P_1 = \begin{pmatrix} p_1 \\ p_2 \end{pmatrix}$, $A_1 = \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}$, and $L_1 = \begin{pmatrix} l_1 \\ l_2 \end{pmatrix}$. By solving

for P_1 , this equation may be rewritten:

$$(h) \quad P_1 = (I - A_1')^{-1} w L_1$$

P_3 , the price for the abatement of one unit of pollution, may be found by evaluating the expression:

$$(i) \quad p_3 = a_{31}p_1 + a_{32}p_2$$

As indicated in the body of the chapter, this simple Leontief system may be extended to include partial abatement of pollution by the productive industries themselves.

IV. GOVERNMENTAL DECISIONMAKING:

A THEORETICAL CONSTRUCT

This chapter serves a dual purpose: (1) to develop a conceptual description of the way government agencies make environmental decisions and (2) to delineate the kinds of information such agencies need in order to promulgate environmental standards. This material is closely related to the economic models discussed in the last chapter, both because those models are applicable in many ways to governmental decisions and because informational needs may be specified, in part, by reference to the models. The investigation of the nature of governmental decisions will be concluded in the next chapter with a look at the actual workings of a regional environmental control agency. In the concluding chapters of the dissertation, these two views--conceptual and empirical--of government decisionmaking will be used to specify the kinds of information accountants might supply to government decisionmakers and to describe the scope of the accounting function within government agencies.

The Selection of Public Programs

In order to develop this conceptual framework most clearly, the existence of a single government decisionmaker is postulated. This arbitrary and admittedly unrealistic

assumption will be lifted shortly, but it is useful at least initially. Now, if this decisionmaker wishes to reach an optimal decision (and to recognize its existence!), he must either consider all potential public programs or else employ an efficient search algorithm.¹ An alternate and equivalent formulation of this necessary condition is that the appropriate social discount rate, that is, the rate of interest at which future costs and benefits from the project are discounted back to the present, must be precisely determined. That these two formulations are indeed equivalent requires some proof and explanation. The connecting link between the two is the economic notion of "opportunity cost."² For instance, the opportunity cost of accepting project A and thus rejecting project B is the net present value of project B foregone. Thus, the opportunity cost of accepting the optimal public project is the net present value of the second-best public project and the appropriate social discount rate for the evaluation of the optimal project is the rate of return foregone.³

¹ An example of an efficient search algorithm is the simplex method of obtaining a solution to a linear programming problem. Such algorithms have been formulated for but a small subset of all optimization problems.

² This argument is based largely upon William J. Baumol, "On the Discount Rate for Public Projects," in Subcommittee on Economy in Government of the Joint Economic Committee, The Analysis and Evaluation of Public Expenditures: The PPB System, Volume I (Washington: U.S. Government Printing Office, 1969), pp. 490-91. Baumol's analysis actually applies to the selection of a public project as opposed to a private one. However, the extension of the analysis to the selection of one among many possible and competing public projects is straightforward.

³ This analysis assumes that there is always the potential

Regardless of which formulation the decisionmaker utilizes, the social benefits and social costs of each potential program must be first identified and then evaluated. The evaluation process consists of two distinct phases. First, the benefit (or cost) must be measured in units which are "natural" in the sense that they relate to an observable characteristic. For instance, a benefit of an electrostatic precipitator installed in the smokestack of a municipal incinerator might be a thinning of the smoke emitted from the stack. Such an improvement could be measured in pounds of particulates per cubic foot of air. Of course, such a measure becomes operational only when it is translated into some common unit applicable to all benefits and costs. Thus the second phase of measurement consists of translating the "natural" measurement into an artificial one, generally dollars, which may be used directly in the evaluation process.

Evaluation methods.--The methodology of benefit-cost analysis has been applied to the selection of public projects. This technique is formally identical to the net present value technique used for business capital budgeting. However, while businesses can often consider relatively concrete revenues, public decisionmakers must usually contend with benefits that are often intangible, ambiguous, or indefinite. Since the technique is discussed with varying degrees of sophistication

"public project" of reducing taxes, that is, leaving funds in the private sector rather than using them for public purposes.

in all public finance textbooks, the discussion below will stress the conceptual bases of the benefit-cost model as they affect decisionmaking.

For the purposes at hand, suppose there is a public project for which all the costs and benefits will occur immediately. Let X_1 denote the dollar amount of the i^{th} cost or benefit, subject to the convention that positive and negative numbers shall represent benefits and costs respectively. The net social benefit, in dollars, of the project may be expressed as

$$B = \sum_{i=1}^n X_i \quad (1)$$

Underlying each X_i , however, is a "natural" quantity and a "social scaling factor." The latter refers to one member of a set of weights (or "shadow" prices) reflecting society's preferences among all social benefits and costs. This factor is needed to map "natural" quantities into dollar amounts which can then be added together. Letting q_i and f_i respectively stand for the "natural" quantity and the "social scaling factor" for the i^{th} cost or benefit, equation (1) may be rewritten as

$$B = \sum_{i=1}^n q_i f_i \quad (2)$$

For most social projects, benefits and costs will stretch over several time periods. All future benefits and costs must be discounted back to the present using a social discount rate. Above it was stated that for any specific decision the appropriate rate to use might be the return on the second-best

project. Such a rate could not be determined until all potential projects were evaluated. Therefore, in this statement of the benefit-cost model, the social discount rate will be interpreted to be the "minimally acceptable" rate for public projects, however determined, and it will be represented by the symbol "r". In a more general reformulation, the net social benefit of a social project may be expressed as:

$$B = \sum_{j=0}^t \left[\frac{\sum_{i=1}^n q_{i,j} f_{i,j}}{(1+r)^j} \right] \quad (3)$$

where

- $q_{i,j}$ refers to the "natural" quantity of the i^{th} benefit or cost occurring at the end of time period j ,
- f is the "social scaling factor,"
- r is the social discount rate, and
- t is the end of the planning horizon

Complications due to uncertainty.--The benefit-cost model must be further modified in order to explicitly consider the large uncertainties which pervade decisionmaking in the public sector. In particular, the "natural" quantities ($q_{i,j}$) are often measurable only by crude approximation. Even the existence of certain costs and benefits is open to conjecture. Typically, $q_{i,j}$ is a random variable which may assume a range of values. Less obviously, perhaps, the "social scaling factors," that is the $f_{i,j}$, are also uncertain. Surely, these weights are functions of several variables including society's income and

its distribution, tastes, the quantity of the cost or benefit in question ($q_{1,j}$), the point in time when the cost or benefit will be received, and many others. Even this brief list of possible arguments for the "social scaling factor" function demonstrates that the $f_{1,j}$ are also random variables and that they are independent neither of one another nor of the $q_{1,j}$. The values of these scaling factors will assuredly shift with changes in society's tastes and, moreover, with the discovery or articulation of new social problems. Conceptually, the benefit-cost model must incorporate the notion of mathematical expectation. Thus, equation (3) should be rewritten as

$$B = \sum_{j=0}^t \left[\frac{\sum_{i=1}^n E(q_{1,j} f_{1,j})}{(1+r)^j} \right] \quad (4)$$

where $E(\text{argument})$ denotes the expected value of the argument.

Equation (4) will be referred to as the "general form of the benefit-cost model."

Some observations.--Upon considering the "general form," some interesting and relevant implications appear. If, for example, one cost of a public project is total annihilation of the human race--presumably an infinitely large cost--the present value of that cost will also be infinitely large so long as the date of the catastrophe is not infinitely far into the future. Moreover, so long as the chance of such an occurrence is finite, its expected value is also infinitely large. Now, many public projects, including those in the area of scientific research,

pollution control, and defense, probably carry potential costs or benefits that are infinitely large. As a practical matter, such benefits or costs have an extremely small, albeit finite, probability of occurrence and are disregarded. This "infinity conundrum," however, demonstrates that the benefit-cost model may not always lead to an unambiguous conclusion. A warning light has appeared: the model must be applied cautiously!

Another implication of the model, and one having greater moment, is the unlikelihood of solving for the net social benefit using analytical methods. The model brings together functions of random variables that are mutually dependent. An analytical solution to the general form is beyond the capabilities of today's mathematics and may be logically impossible. However, the technique of simulation remains, at least in theory, a promising alternative.

Adding realism: a multiplicity of decisionmakers.---The first assumption stated for the model developed above was the existence of but one decisionmaker. Actually, many governmental agencies have responsibilities for decisionmaking concerning social problems such as environmental disruption. First, multiple levels of government are involved. Typically, these levels are three: federal, state, and local. At times, however, international units and intermediary units (i.e., between federal and state governments or between state and local governments) become involved. An important goal, implicit in much of the recent literature in public finance, is to obtain congruence

between the scope of a public problem or issue and the span of authority of the government unit responsible for the related decisionmaking.⁴ From one viewpoint, this goal seems rather obvious. Consider the problem of water quality. Obviously, a single local government cannot be expected to make the proper decision, from the standpoint of society as a whole, when the river running through the town has its headwaters two hundred miles upstream, its mouth a similar distance downstream, and its banks heavily populated throughout. The opposite viewpoint, considering a rather local problem, is also relevant. Musgrave and Polinsky cite the need for "diversity" and efficiency as reasons for charging the handling of such a problem to the local government.⁵ Thus, the geographical scope of the benefits and costs of a particular

⁴For example: Harvey E. Brazer, "Some Fiscal Implications of Metropolitanism," Governmental, Fiscal, Guthrie S. Birkhead (Ed.) (Syracuse, New York: Maxwell Graduate School of Citizenship and Public Affairs, 1962), pp. 61-82.

Research and Policy Committee, A Fiscal Program for a Balanced Federalism (New York: Committee for Economic Development, 1967).

Joseph A. Pechman, "Fiscal Federalism for the 1970's," National Tax Journal, Vol. 24, No. 3 (September 1971), pp. 281-90.

The clearest statement of this doctrine seems to be contained in Richard A. Musgrave and A. Mitchell Polinsky, "Revenue Sharing--A Critical View," Financing State and Local Governments (Boston: Federal Reserve Bank of Boston, 1970), especially pages 17-19. This principle is essentially what those authors term "equivalence" and "correction for spillovers."

⁵Op. cit., pp. 17-18.

public program must be examined, and in the corresponding level of government must reside the appropriate decisionmaking authority.

Not only must the different levels of government be considered as potential decisionmakers, the possibility that more than one agency at a given level may become involved must be examined. The existence of such "parallel" agencies signals the need for a systems approach: in this setting, the same mission (or parts thereof) is performed by several agencies, but the agencies and their programs are often not organized along lines of missions.⁶ Referring again to water quality as an example, there may be several local agencies; including a water board, a health department and a recreation department; having some authority. This situation often leads to fragmented decisionmaking unless the specific tasks to be performed can be specified and coordinated. To a large degree, the parallel agencies complication represents an administrative problem. One way--perhaps the best way--to solve it is to reorganize agencies along mission-oriented lines. This method was followed in setting up the Federal Environmental Protection Agency and similar environmental authorities in state governments.

A Pragmatic Approach to the Selection
of Public Projects

The limitations and implications, discussed above, of the

⁶C. West Churchmen, The Systems Approach (New York: Dell

general form of the benefit-cost model demonstrate a clear need for a simplified decision strategy. Government decisionmakers must use a modified approach which, while remaining reasonably consistent with the general form, can be readily understood both by government officials and the public. In this section, a pragmatic approach to the formulation of decision strategies will be presented. This method will not consider the problem of multiple government agencies. Hopefully, the principles mentioned in the previous section--specifically congruence between a problem's scope and a government agency's span of authority and the use of a "systems approach"--will become more widely applied.

A basic decision criterion.--It is proposed here that the following, simplified rule be used to make decisions concerning social projects: accept only those projects whose social benefits "substantially" outweigh their social costs. This rule, although obviously simplistic, is nonetheless nontrivial; for it implies that the social benefits and the costs be first identified and then evaluated using some selected social discount rate, in order to determine whether the project has a sizeable "net social benefit." Since it seems likely that many potential public projects would qualify under this rule, why accept any others?

The social discount rate to be employed could also be

chosen in a pragmatic manner. One approach might be to use, rather simply and arbitrarily, the interest rate on high-grade government or corporate debt instruments with a maturity approximating the life of the project being studied. Selecting the appropriate social discount rate in such a fashion virtually ignores an issue that has been often discussed but largely unresolved in the public finance literature.⁷ However, the resolution of this specific difficulty merits but second priority in comparison with the need to identify, quantify, and evaluate social benefits and social costs.

In certain cases this basic rule can be applied rather easily. There are some projects for which at least one of the following conditions holds:

- (1) Nearly all of the social costs may be estimated.
- (2) Nearly all of the social benefits may be estimated.
- (3) Both (1) and (2) hold.

For projects falling into class (3), benefit-costs comparisons are straightforward. Moreover, for some projects in classes (1) and (2) crude comparisons may be sufficient. As an illustration, consider a project which has a total present value for its social benefits of \$100,000. With benefits thus quantified it might be obvious that the present value of the project's social costs could be nowhere nearly as large (or, conversely, nowhere nearly as small). This same method might

⁷See, for example, Baumol, op. cit.

be useful if the social costs but not the benefits can be quantified.

Thornier situations.--Although the technique of "crude comparisons" outlined above may often be applicable, certain situations do not lend themselves to such a simple approach. For many potential public projects neither the social costs nor the social benefits can be estimated with a reasonable degree of accuracy. In these cases, it is very probable that significant social benefits accrue to a project that is flexible in terms of its size, its ease and frugality of abandonment (bail-out), or its ready convertibility into a new project. Such flexibilities would allow the government agency to begin a project, evaluate it in midstream, and decide whether to continue according to original plans or to modify the program.

Another formidable situation occurs if rough comparisons fail to lead to a definite decision. In other words, it may be true for some potential projects that either the social benefits or the social costs may be estimated, yet it may not be clear that the unmeasured factor greatly exceeds or falls short of the estimated factor. The situation is, accordingly, indeterminate. A useful procedure to follow in this case might be to study the proposed project further, if such research is not inordinately costly. Perhaps some sort of decision rule could be established where further study would be ordered if it could be obtained at a cost not exceeding a certain percentage of the project's total estimated social benefits or costs.

If the cost of further study does not appear to be reasonable, due to either its expected cost or its probable ineffectiveness, then the proposed public project should not receive high priority.

Dynamic Aspects of Environmental Disruption Control

Once regulations have been established to control a certain form of disruption, the role of the policy-setter (government agency) becomes one of re-evaluating the standards in order to cope with changed conditions. For certain regulations, this review may be required only periodically, perhaps even at intervals ranging up to several years. For other regulations, the re-evaluation process must be virtually continuous. This section will focus on planning for changes in standards: how can the government agency determine when a change is necessary and how might the re-evaluation function be incorporated into legislation which establishes an original standard?

When should standards be modified?--Under the theoretical model developed earlier in this chapter, an abatement standard for a given type of environmental disruption is based upon a set of variables. (In a less specific manner, actual regulations are determined with regard to a set of existing conditions.) If the values assumed by these variables change, the appropriate level or form of the standard may change as well.

One class of variables which may assume new values over time comprises physical conditions. For example, there may be a change in the ambient amount of a specific sort of disruption, perhaps due to the implementation of controls. In some cases, the existing level of control may actually be too restrictive; resulting in the attainment of a standard but at too great a cost. With all of the uncertainties involved in its setting, it is unrealistic to assume that the initial standard will be exactly on target: it seems safe to say that, more often than not, the standard will be either too restrictive or too lax.

A second potential cause for a change in the amount of disruption could be either growth or contraction of the underlying activities or a change in their form. Such changes may themselves be secondary effects of the standard. For instance, a pollution standard requiring a type of filter network for cooling-water leaving a steel plant might cause the firm to curtail production due to higher costs or to change its production process to avoid the need for control. It is also possible that the demand for the firm's product or a change in the product may have come about for reasons not related to pollution control.

Changes in the amounts of other forms of environmental disruption may have impact on the appropriate standard for a particular form. For example, a sharp reduction in hydrocarbons emitted from automotive exhausts might call for either a loosening or a tightening of the standard for emissions of nitric oxides. One reason for this might be that health problems are related to the discharge of both pollutants together. While

this is merely an illustration, interrelationships among many forms of disruption have been studied. Another similar change might be the identification of a new form of disruption, causing the decisionmaker to rethink his approach to controlling the forms identified previously.

Values for variables other than physical conditions might change as well. Society's tastes do not remain constant over time and, hence, the "social scaling factors" do not remain constant. In addition, the appropriate social discount rate very likely changes. Since public projects vary in their time-patterns of benefits and costs, a rate change could significantly alter the conclusions of the decisionmaker. Finally, the amount of knowledge concerning the effects of various types of environmental disruption grows over time. Opinions and conclusions that seemed correct when a standard was first promulgated may be refuted by experience or later research. For all the reasons mentioned above, standards should be considered to be subject to modification at rather frequent intervals.⁸

Legislating the re-evaluation process.--Since many changes in standards may be called for, it seems appropriate that

⁸A countervailing consideration is, of course, the disruption to the production process caused by frequent changes in the standards. Therefore, the specific type of change made to a standard should be carefully considered. This topic seems beyond the scope of this paper except to note that here is an additional incentive to provide standards that are flexible in the sense discussed in the paragraph headed "Thornier situations" on page 87.

certain planning provisions be incorporated into any legislation setting forth environmental disruption abatement regulations. A high official of the Environmental Protection Agency once expressed his view that a hoped-for result of standards severely regulating automobile traffic in several major downtown areas was to motivate the Congress to reconsider its goals for control of automobile emissions.⁹ The need for continuing planning and reassessment was also recognized by Congress itself when it delegated to the EPA the authority to postpone for one year the effective date of stricter automotive emission.¹⁰ However, the planning function could be specified much more clearly in legislation. Laws could contain deadlines for establishing revised standards which would require either the EPA or the Congress to take a new look at the situation after initial regulations had been in effect for a specific period.

It may also be possible to set standards that are "dynamic" in the sense that the level of control they require is based upon observable variables. This technique would seem to be possible under two different circumstances. First, the method of control may be flexible and amenable to "fine tuning." An example of this situation would be the use of coal to generate electricity. The standard could be established in such a way as to require the average sulfur content of the fuel to be varied.

⁹ "EPA Softens Plans for Gasoline Rationing in Cities, but Keeps Other Transport Rules," Wall Street Journal, October 16, 1973, p. 3.

¹⁰ Such a provision was included in the 1970 Clean Air Amendments.

Accordingly, during certain periods--perhaps based on weather conditions--low-sulfur (and thus expensive) coal would be used. At other times high-sulfur coal, obtainable at a lower price, would be burned. A continuous range of sulfur content and cost could be utilized.

The other situation that would allow the use of dynamic standards occurs when there is a definite, secular trend in the observable variable. Both the government agency and private firms would therefore be able to estimate the required future level of control with reasonable accuracy. It must be stressed that the use of flexible, dynamic standards in either of these situations would be predicated upon the development of environmental information systems that would, with an appropriate degree of reliability, furnish decisionmakers with timely and adequate information.

Information Required for Economic Analysis

As part of their policy-setting activities, federal agencies must study the impact of disruption and its control on the national economy and on individual industries. Agencies within state and local governments perform similar analyses, albeit with reference to a limited geographical region. Moreover, these agencies must also consider the environmentally-related activities of single firms. The information needed for such economic studies will be specified by reference to the theoretical models discussed in the previous chapter as well as the benefit-cost approach described above. In Chapter IX,

the problems that economists encounter in the use of accounting data as inputs to such studies, as well as potential solutions to those problems, will be investigated.

The theoretical models described in Chapter III may be classified as micro-economic, pertaining to individual firms and industries; macro-economic, pertaining to the national economy; or inter-sectoral (input-output), pertaining to the interrelationships among the various producing and consuming sectors of the economy. All of these models require various data concerning the damages done by environmental disruption as well as the costs of disruption control. At this point, the types of costs falling into either category, as well as the problems inherent in their evaluation, will be discussed.

Ridker suggests a three-way classification scheme for the costs incurred by an individual (or firm) that encounters disruption.¹¹ One, the individual may incur costs in the avoidance of disruption. For instance, in response to polluted air in his metropolitan area, a person may move to a new neighborhood or may travel further to find pristine surroundings for his summer camping trip. Two, the individual may incur costs in enduring disruption. Examples of such costs, in the air pollution setting described above, might include more-frequent painting of the person's home, increased frequency and severity of respiratory illnesses, installing air-conditioning, and such

¹¹Ronald G. Ridker, "Strategies for Measuring the Cost of Air Pollution," The Economics of Air Pollution, A Symposium, edited by Harold Wolozin (New York: W. W. Norton and Company, 1966), p. 93.

"psychic" costs as "letting the walls get dirtier."¹² Three, the individual may incur costs in attempting to abate disruption, most commonly by undertaking some type of "political" action.

These three kinds of costs related to damage from disruption enter into the micro-economic model in the construction of the marginal-harm curves shown graphically on page 48 (MH_q) and on page 50 (MH_a). Without evaluating such costs, at least implicitly, the amounts of production and disruption that should be permitted cannot be specified. Under the macro-economic, "disproduct" approach, the grand total of these damage costs must be calculated and subtracted out in the determination of "net economic welfare" or some such measure. Lastly, these costs must be studied as part of the input-output approaches in order to compute the "value" of disruption "delivered" to final consumers.¹³

Estimates of damage costs may be developed by three conceptually-distinct methodologies.¹⁴ First, the direct costs of pollution damage, exclusive of the costs incurred by individuals and firms in making adjustments to reduce the impact of disruption on themselves, may be measured. Second, the costs, incurred by individuals, falling into each of the three

¹² Ibid., p. 95.

¹³ Wassily Leontief, "Environmental Repercussions and the Economic Structure: An Input-Output Approach," The Review of Economics and Statistics, LII, No. 3 (August 1970), p. 267.

¹⁴ Ridker, op. cit., p. 89.

categories described earlier may be ascertained. Third, the complete impact of disruption on the economy may be evaluated. Ridker considers this third approach, the taking "into account (or) social interactions, the effects of one person's actions upon another," to be "the only completely adequate way to measure the social losses involved in additional levels of pollution. . . ."¹⁵

Regardless of which methodology or combination of methodologies are employed to evaluate damage costs, numerous practical difficulties are encountered. Ridker provides descriptions of many such problems in the presentation of several studies of the costs of air pollution.¹⁶ Moreover, since the specific nature of damage costs incurred varies greatly among individuals and among disruption forms, it does not seem possible to draw useful generalizations about the techniques used to quantify such costs in physical terms and then to evaluate them, beyond presenting an overall model such as the one included in this chapter.

While many of the measurement perplexities related to damage costs pertain to abatement costs as well, some types of the latter may be handled in a straightforward fashion. Such items as the capital and operating costs of abatement devices are simply more concrete and easier to handle than are most damage costs. Often times, these control costs can be

¹⁵ Ibid., p. 95.

¹⁶ Ronald G. Ridker, Economic Costs of Air Pollution (New York: Prager, 1966).

obtained from engineering estimates if not from market prices and actual past experiences of firms. However, complications do arise in trying to specify the relationship between total damage and abatement costs and varying levels of production and disruption. It is at this stage that a need arises for an understanding and quantitative formulation of production functions for firms. In economic terms, such a function shows the relationship between inputs of land, labor, and capital and the output of a firm. Knowledge of these functions is an explicit prerequisite to applying either the microeconomic or the inter-sectoral models: the production function for an industry underlies the construction of its supply curve as well as its technological coefficient for input-output analysis. At the level of the individual firm, such a function is based upon the costs of production. Production costs also comprise one of the building blocks underlying macroeconomic models.

Transaction and administrative costs related to control of disruption are quite often sizeable. Such costs range from the expenses incurred in operating regulatory agencies to the costs shouldered by individual residents in trying to bring social pressure to bear against a local polluter.

In short, the data needed by government agencies for economic analyses, under any of the three general approaches outlined in Chapter III, as well as for specific benefit-cost calculations, include the costs of harm from disruption, abatement costs, production functions or cost curves, and transaction and administrative costs. In the next chapter,

the workings of an actual pollution control agency will be described. Then, in Chapter IX, it will be possible to combine these two viewpoints, conceptual and empirical, in order to draw conclusions about (1) the feasible and reasonable role for the accounting function within government agencies and (2) the possible ways in which the accounting function, within government agencies and within individual firms as well, might provide some of the informational inputs for economic studies. Also at that time, the problems economists typically encounter in the utilization of accounting data, and potential solutions to those problems, will be discussed.

V. GOVERNMENTAL DECISIONMAKING: AN EMPIRICAL STUDY

A conceptual structure concerning governmental decisions about environmental control was developed in the previous chapter and was based upon the economic considerations examined in Chapter III. Since both of those chapters described difficulties that are inherent in making operational and specific decision methodology, some empirical study of the actual activities of a government agency can add useful insights. While the case study to be presented below cannot serve as a proof of any general propositions, it can provide an illustration of the relationships between theory and practice, thus indicating the potential fruitfulness of the conceptual framework as well as the level of sophistication of real-world decisionmaking.

The specific agency to be analyzed is the Air Pollution Control Division of the Wayne County (Michigan) Department of Health. The analysis will be divided into several major sections, the first of which will examine the history of the Division and the development of its duties. The next three sections will comprise a discussion of the activities of the Division at the present time, an in-depth study of the regulation of one specific pollutant, and a consideration of a management information system for the Division. The final section will compare this real situation to the theoretical construct presented previously.

The Development of the Division and Its Duties

Early history.--On June 7, 1887, the Common Council of the City of Detroit adopted an ordinance prohibiting, as a public nuisance, the emission of black or dense grey smoke from smokestacks.¹ To enforce the provision of the ordinance, the Smoke Abatement Bureau was created. That agency was the direct predecessor of today's Division. The original agency was later shifted around several times within the organizational structure of city government, but retained the same basic functions into the early 1960's. At that time, there was also a small air pollution unit within the Wayne County Board of Health and a similar agency within the Michigan Department of Health. However, the State agency was of little significance, particularly to Wayne County.

Impact of the Federal Air Quality Act.--In 1967, Congress passed broad amendments to the Clean Air Act. As mentioned in Chapter II, that legislation contained mechanisms for cooperation between the Federal government and the states in order to promulgate standards and enforcement plans for "air quality regions."² An important part of this program was

¹The history of the Division was related by its Publicist, Mr. Howard Murray, in a personal interview held during October, 1973.

²See page 31.

the provision of Federal funding for local abatement agencies. In late 1968, the Wayne County Board of Commissioners combined the existing city and county agencies into the Air Pollution Control Division.³ Initially, funds for the agency were derived from three sources: (1) Federal grants, (2) State grants (the ratio of Federal aid to State aid was 3 to 2), and (3) revenue generated locally from permit and inspection fees. The State of Michigan subsequently adopted legislation providing for State-assessed surveillance fees and the return of a proportion of them to the local regulating agency, if any.⁴ In addition, the local assessment of any fees was prohibited. Federal funds continue to be secured by making an annual, formal grant application. While this procedure, in effect, requires the Division to adopt certain aspects of program budgeting, the Division remains essentially on a conventional "line-item" budget for operating purposes. Budgetary procedures will be analyzed in some detail in the section of this chapter concerning the development of a computerized information system for the Division.

Relationship to Michigan's state agency.--The Michigan Air Pollution Control Commission, a unit within the Michigan Department of Natural Resources, has direct jurisdiction over air pollution in all geographical subdivisions of the state that do not have a local control authority. At the present time, several local agencies exist. Of these, the Wayne County

⁴This was house Bill 4260.

Division has by far the largest staff, even outnumbering State Commission.

The Division has no specific, functional reporting obligation to the State Commission, although the recently adopted pass-through of State imposed surveillance fees based upon the Division's costs of operation appear to impose a need for some type of budgetary reporting. Conversely, although the State Commission requires each potentially-polluting establishment to file an annual Reporting Form, this information is not now forwarded to the Division⁵

Without exception, the regulations in effect in Wayne County are at least as stringent as those adopted at the State level. As a result, there is no conflict between the overall responsibility of State government for air quality within Michigan and the operations of the Division within Wayne County.

Relationship to the EPA.--The Federal Environmental Protection Agency (EPA) was established subsequent to the passage of the 1970 amendments to the Clean Air Act.⁶ Among its many responsibilities, this agency was charged with the establishment of air quality standards for six categories of

⁵This "Michigan Air Pollution Reporting Form" is reproduced in the Appendix to this chapter.

⁶See p. 32 above.

pollutants:

- (1) Particulate matter
- (2) Carbon monoxide
- (3) Photochemical oxidation (smog)
- (4) Sulfur oxides
- (5) Nitric oxides
- (6) Hydrocarbons

Under the 1970 Clean Air Amendments, the States were required to meet the primary National Ambient Air Quality Standards by 1975 and the secondary Standards by the following year. Primary standards are those needed to protect human health; secondary standards protect vegetation, materials, and aesthetics. The standards comprise both annual averages and extreme values to be exceeded no more than once a year. Accordingly, each State was to submit, to the EPA in 1971, an implementation plan covering (1) specific emission standards to be imposed, (2) techniques to be used for air monitoring, and (3) such organizational details as personnel, equipment, and financing.

Upon review by the EPA, Michigan's implementation plan was held to be deficient in certain ways. First, no specific procedure had been developed to furnish to the public information contained in the "emissions inventory." Next, the emissions standards that had been specified for sulfur dioxide and for nitric oxides were deemed to be inadequate. Finally, the wording of the procedures to be followed

in establishing and operating the permit system had not contained a specific link to the national air quality standards. All of these deficiencies were subsequently eliminated.

The Division has a continuing relationship with the EPA in that the Division's annual request for federal funds is evaluated by that agency.

The Activities of the Division Today

The Division is now well into the process of making the implementation plan operational. The types of air pollution problems receiving the most attention in Wayne County are particulate matter and sulfur oxides. This emphasis is consistent with the priorities specified by the EPA: the two pollution forms just mentioned were rated "priority one" and the remaining four forms were rated "priority three". According to the EPA, "priority one" refers to a pollutant that has a monitored level clearly exceeding the national standards, and hence requiring intense abatement efforts.⁷ "Priority three" refers to a pollutant that has a level safely within the standards.⁸

With the exclusion of motor vehicles, which are covered by specific federal regulations, there are some fourteen or fifteen thousand individual, potential sources of air pollution within Wayne County.⁹ Most of these are now controlled to an

⁷Environmental Quality-1973, p. 274.

⁸Ibid., "Priority two" refers to a pollutant that has a level which approximates the standard.

⁹The Division, through the Wayne Country Public Health

acceptable degree. Abatement has been achieved through a wide array of methods which, however, may be generally categorized as (1) control devices, (2) fuel changes (e.g., substitution of relatively low-sulfur fuel oil for high-sulfur coal), or (3) curtailments of activities. Indeed, the likely methods of abatement for particular forms of pollution were, at times, explicitly considered in the setting of standards, and standards that might have necessitated unbearably high costs were rejected. Characteristic of this approach to control is the wide difference between the maximum allowable particulate-emission-rate for jobbing foundries and that for, say, steel manufacturers.¹⁰

While this general topic of standard-setting and similar decisionmaking will be considered presently in the context of a specific case history pertaining to the abatement of sulfur dioxide emissions, the remainder of this section will deal with the Division's actions to achieve compliance with standards and to enforce its regulations.

Statutory Authority: An Overview

The duties and powers of the Division rest upon both

Director, does have the residual power to curtail the operation use of motor vehicles as well as the operation of any other pollution source in the event of an "air pollution alert." Wayne County Air Pollution Control Regulation, Section 2.2A: "Emergency Powers of the Public Health Director."

¹⁰Ibid., Section 6.2.

County and State statutes and administrative procedures. The following paragraphs will outline these sources of authority, beginning with those provided on the County level.

Permit system.--This is the basic regulatory device for all new or modified sources of potential pollution; it will be discussed at some length after this overview is concluded.¹¹

Emergency powers of the public health director.--If he has evidence that ~~any~~ source or group of sources of air pollution represents a serious and imminent threat to human health, the Public Health Director has the authority to order the activity ceased or modified.¹² Furthermore, the Director is empowered to seek a restraining injunction against any person who fails to comply with such orders. As a means of implementing these "emergency powers" in a coherent and effective manner, the Division has developed a set of contingency plans outlining what special procedures should be activated depending upon the seriousness of the pollution conditions at hand.

Emission of visible contaminants.--This regulation is, in effect, a modern, scientifically-precise formulation of the original anti-smoke ordinance that led to the creation of the city agency which eventually became the Division¹³.

General powers.--Three sections of the Wayne County Air

¹¹Ibid., Article IV

¹²Ibid., Section 2.2A

¹³Ibid., Section 6.1

Pollution Control Regulation, Taken together, imply a broad base for the authority of the Division.¹⁴ Outlawed is any air pollution that is injurious to human health, comfort, or safety; damaging to property or business; or causing the national primary or secondary standards to be exceeded in Wayne County. Furthermore, any action which has as its only function the concealment or dilution of emissions without any overall reduction thereof is likewise banned.

Violation notices.--A specific procedure is provided for situations where the emissions from a source violate the county regulations.¹⁵ After the violation notice has been issued, the person cited has thirty days in which to provide information refuting the alleged offense. Subsequently, the violation notice is either affirmed or withdrawn. If affirmed, the person or firm cited may request an emissions test, leading to either the substantiation or voiding of the violation notice. If three or more violations have been affirmed with respect to a single source during any twelve-month period, the Division may initiate action to seal (shut down) that source.¹⁶

Emissions testing.--Specific authority is given to the Division to conduct tests of the emissions from any source. Furthermore, the operator of a source is required to provide

¹⁴Section 6.5: "General Prohibition," Section 6.7: "Circumvention," and Section 6.9: "Compliance with National Ambient Air Quality Standards."

¹⁵Ibid., Article VII: "Procedural Requirements."

¹⁶Ibid., Article KI: "Sealing."

the required points of access to permit technically-adequate samples to be taken.

State legislation.--While broad statutory authority is available under Wayne County regulations, the main thrust of enforcement thereunder comes in the form of criminal actions. The penalty for violation is a one-hundred-dollar fine or a jail sentence of ninety days.¹⁷ While some provision is made in the County Regulation for injunctive proceedings of a civil nature,¹⁸ a specific mechanism for the bringing of civil lawsuits by the Division (or by any legal entity for that matter) is provided in the Michigan Environmental Protection Act of 1970.¹⁹

Controlling New Sources

With the above catalog of the Division's statutory authority serving as a frame of reference, the discussion will now turn to the actual ways in which the Division has managed to obtain compliance with its regulations. The "permit system," applicable to all new or modified sources will be treated first.²⁰

This approach pertains to the construction, installation, or alteration of almost any potential source of air pollution. There are, however, two general groups of sources that are not covered by this regulation. The first excepted group, comprising

¹⁷ Ibid., Section 14.1: "Penalties."

¹⁸ Ibid., Section 14.3.

¹⁹ P. A. 1970, No. 127.

²⁰ Ibid., Article IV: "Installation Permit and Certification of Operation."

all transportation equipment and all internal combustion engines, is subject instead to specific, federal standards and enforcement procedures. As mentioned previously, the Division does retain certain emergency and residual control over such sources. The second group not included under the permit system consists of many diverse kinds of minor sources.²¹

For all covered sources, the procedure begins with an application for an "installation permit."²² Information furnished in support of this application must include the technical specifications for the equipment or process and must be sufficient to demonstrate that the equipment or process will be operated within the emissions limits for air pollutants. The Division must evaluate the application and provide a timely (within thirty days) approval or rejection of it. This evaluation is performed by the Engineering Section of the Division. The technical plans and calculations are checked and, in many cases, staff members work with personnel from the applicant firm to modify plans in order to meet standards.

Once the installation has been completed, a final inspection is made by the Engineering Section, often in consultation with the Technical Services (emissions monitoring) and Enforcement (field inspection) Sections. Tests of the actual

²¹ Ibid., Section 4.7: "Exemptions from the Permit System."

²² There are actually two types of installation permits, industrial and commercial. However, this distinction is apparently only administrative; there is no mention of these two types in the actual Regulation.

emissions from the installed device may be ordered if the Division has reason to believe that such emissions may be excessive. Only after the inspection has been concluded favorably is a Certificate of Operation issued and actual operation allowed to commence.

According to the County Regulation, reinspections to renew the Certificate of Operation may be required by the Division, at intervals no more frequent than annually.²³ It is the Division's current policy, however, to inspect each source yearly.

Controlling Existing Sources

The control of excessive emissions from new sources is considerably facilitated by the permit system. With an existing source, however, a necessary prerequisite to control is the awareness that a problem exists. There are four ways in which the Division may become informed of a condition requiring attention: (1) a citizen may lodge a complaint with the Division; (2) an inspector from the Enforcement Section may happen to observe something that arouses his interest; (3) a problem, potential or actual, may be uncovered during the process of preparing a general "emissions inventory;" or (4) the problem may be recognized during an inspection relating to an Installation Permit or a Certificate of Operation.

²³Ibid., Section 4.10.

Once the problem has been noted, the Division attempts to have the person or firm responsible correct it. In situations where voluntary agreement is not forthcoming, the Division will bring suit under the Michigan Environmental Protection Act, with the intention of obtaining a "consent judgement." This method has been quite successful as illustrated by the recent agreement by the Ford Motor Corporation to an abatement plan for its Rouge Plant.²⁴

Regulating Sulfur Oxides Emissions:

A Case History

While the activities of the Division were outlined in the paragraphs above, no specific mention was made of how this agency made decisions related to the abatement of air pollution. Accordingly, a review will now be made of the agency's decisionmaking concerning a particular pollutant, sulfur oxides. The development of emission regulations will be traced from the adoption of the underlying legislation by the U.S. Congress, through the research and promulgation of national primary and secondary standards by the EPA, to the actual implementation of specific abatement limits by the Wayne County Division. (The next step in the chain, that of decisionmaking within an individual firm concerning the methods it will follow in order to achieve compliance, will be presented in Chapter VII.) The

²⁴"Ford to Clean Up Rouge Plant," Detroit Free Press, August 2, 1973, p. 3-A.

approaches to making decisions will be compared to the conceptual notions discussed in the previous chapter.

Sulfur oxides have been selected as the pollutant to be examined in this analysis because, prior to the development of the national air quality standards, their emission had not been regulated in Wayne County. Hence, the Division had to decide upon totally new regulations. However, this case history should furnish a useful illustration of environmental decisionmaking by government agencies in general.

The nature of the problem.--Sulfur oxides pose a serious health hazard and cause the worst damage, among all forms of air pollution, to plant life and inanimate objects.²⁵ The source of this problem is the combustion of fuels--primarily coal and high-sulfur oil--largely in the generation of electric power, but also in the operation of many industrial plants.²⁶ Sulfur dioxide attacks the human respiratory system; sulfur trioxide, when mixed with water, will form sulfuric acid; and, when particulate emissions are also present, health hazards are compounded.²⁷

Approaches to the control of sulfur oxides emissions,

²⁵

Environmental Quality-1970, p. 80.

²⁶The total emission of sulfur oxides has been attributed to the burning of various fuels as follows: coal, 60 percent; oil, 14 percent; other industrial processes using sulfur, 22 percent. Ibid., p. 63.

²⁷Ibid., p. 68.

other than curtailment of the underlying activity, consist of (1) switching to a fuel with naturally-lower sulfur content, (2) processing the fuel to remove the sulfur, or (3) removing sulfur oxides from the stack gases. Each of these approaches, however, poses considerable problems in its implementation. Due to the fuel shortage that has become increasingly evident during the past few years, the availability of low-sulfur fuel in sufficient quantity is, at best, uncertain.²⁸ Processes to remove sulfur from fuels are costly or primitive or both. Finally, there as yet exists no large-scale process to remove sulfur oxides from stack gases, although scrubbing systems are thought, by some experts, to have considerable potential.

Action by the Congress.--As mentioned in Chapter II, The Air Quality Act of 1967 provided the basis for Federal activity in the abatement of air pollution, other than that caused by motor vehicles. That legislation authorized the establishment of National Air Quality Standards. Subsequently, the Department of Health, Education, and Welfare released information pertinent to air quality criteria and control methods for sulfur oxides (and other pollutants.)²⁹ The 1970 Clean Air Amendments required the Environmental Protection Agency to develop specific ambient

²⁸In response to the fuel crunch of the Winter of 1973-1974, the Federal government provided for the temporary suspension of environmental regulations in order to permit utilities to make more extensive use of coal. "Senate Approves Pullback on Air Pollution Standards," Detroit Free Press, June 16, 1974, p. 15-E.

²⁹Environmental Quality-1970, p. 75.

air quality standards and provided a mechanism by which the States would submit implementation plans dealing with the control of air pollution at the State and local levels.

Action by the EPA.--National Ambient Air Quality Standards were promulgated by the EPA very soon after that agency was established in 1970. In essence, the EPA reviewed the information published by HEW--essentially "an outline of the medical research then on record in relating air quality to health effects"-- and, taking its legislative mandate to call for eliminating all risk to human health, the agency set primary standards.³⁰ In a similar fashion, the agency set secondary standards designed to protect materials and vegetation. Serious questions have since been raised concerning the appropriateness of these standards because they were based on research that was often tentative in nature and because no real attention was devoted, by either Congress or the EPA, to the benefit-cost comparisons.³¹

Action by the Air Pollution Control Division.--As mentioned above, no control over the emission of sulfur oxides had existed in Wayne County prior to the establishment of national standards by the EPA. Within the Division, a decision was quickly reached to adopt emissions limits for sulfur oxides that would meet those national standards but would not surpass

³⁰Jude Wanniski, "How the Clean Air Rules Were Set," Wall Street Journal, May 29, 1973, p. 14.

³¹Ibid.

them, except perhaps for a margin of error. In other words, no attempt was made to set a goal that would make the air in Wayne County more pristine than required by national standards.

For two general reasons, this very approach would appear to be the most reasonable, at least for State-local agencies having jurisdiction in heavily-populated and industrialized regions. First, the standards promulgated by the EPA are widely considered to be very stringent; few, if any, large communities would feel a great need to exceed them. Second, the technical expertise and the ability to assimilate the voluminous research on environmental quality is probably much more available to the EPA than it is to State and local agencies: "complete" benefit-cost studies pertaining to major air pollution forms, difficult as they are for a federal agency to formulate, are likely to prove unmanageable at the State and local level. Agencies at these levels, for the foreseeable future at least, are likely to limit their decisionmaking to a narrower or "constrained" problem, that of finding an efficient way to meet federal standards.

The Division proceeded to solve such a constrained problem with respect to sulfur oxides. The first step was to survey each source in Wayne County, collecting data about the nature of the production process and types of fuel being used. Based upon engineering relationships, four hundred fifty thousand tons of sulfur oxides were estimated as being emitted annually in the county. Since the federal standards refer to the concentration of sulfur oxides in the air at any given time, rather than the

emission rate of the pollutant, the estimate of annual emissions was analyzed further using atmospheric dispersion models. These models reflect how given emission rates are related to ambient concentrations in the air at some time and location after emission. Based on this analysis and the federal, primary, annual standard of .03 parts of sulfur oxides per million parts air, the Engineering Section of the Division determined that average emissions would have to be cut in half.

After establishing an overall abatement target, the Division began to formulate specific compliance standards of two kinds: (1) limits on the sulfur content of the fuel burned and (2) limits on the actual emission of sulfur compounds. Firms may comply by meeting either kind of standard.³² From an economic theory standpoint, this approach is commendable: more efficient (in terms of cost) than input standards.³³

These standards were set according to the types of fuel burned (pulverized coal, other coal, light fuel oils, and heavy fuel oils) and the types of processes involved (control electricity or steam generation, residential and commercial space and water

³²Wayne County Air Pollution Control Regulation, Section 6.3: "Emission of Sulfur Compounds."

³³Edwin S. Mills, "Economic Incentives in Air-Pollution Control," in the Economics of Air Pollution, A Symposium, edited by Harold Wolozin (New York: W.W. Norton and Company, 1966), p. 44. Mills further states that "effluent charges" would be still more efficient.

heating, and all others). Increasingly-stringent limits were set to become effective annually through 1976.³⁴ In establishing the different compliance standards, the Division considered various characteristics of the several different types of processes. One factor that was examined was the availability of alternate fuels. For instance, residential furnaces that use light fuel oils could not readily be adapted to provide the preheating that is necessary for the use of heavier oils, such as those often used by electric utilities. Similarly, different processes often produce emissions of somewhat different natures and use stacks of different heights. Surely effluents disperse differently from a home furnace than from the tall stack of an electricity-generating plant. Lastly, the Division determined what was the best available control practice for each category of sulfur-oxides source.

Several information sources were tapped by the Division in its standard-setting activities. Explicit attention was, of course, paid to the applicable National Ambient Air Quality Standards. Data from the county emissions inventory was utilized and air-monitoring facilities were established to ascertain the actual ambient concentrations of sulfur oxides. Technical publications of diverse types were consulted. Furthermore, in order to get industry's general views on abatement and specific opinions of the feasibility of various abatement

³⁴Wayne County Air Pollution Control Regulation,
Section 6.3.

methods, numerous discussions were held with representatives of private firms. Public hearings were also conducted, but Division personnel have commented that participation and interest were slight.

Theory and practice compared,--Upon considering the Division's approach to developing compliance standards for sulfur oxides, it seems apparent that the agency in effect used a crude and approximate form of the benefit-cost model described in the previous chapter. Since the Division accepted the national standards as its own target, the analysis of benefits became quite narrow: the only benefit for each proposed regulation was the extent to which it would reduce emissions of sulfur oxides. Moreover, abatement costs were not explicitly considered, although they were implicitly "picked up" in the specification of best available practices. Similarly, no "hard" analysis was made of the likely costs of administration and enforcement of alternate approaches to control. Still, the Division's definite consideration of different categories of sources and alternative compliance measures (ie., fuel sulfur content or emission rates), as well as its use of a broad range of informational inputs did embody the "spirit" of the conceptual model by providing a good basis for analyzing the many factors affecting such decisions.

Chapter IX will contain a discussion of the scope of the accounting function within government agencies. In particular, the need for accountants to be involved in the design and operation of comprehensive information systems for such agencies

will be demonstrated by reference to a specific proposal for building such a system for the Wayne County Air Pollution Control Division. But first, the examination of the nature of environmental decisionmaking must be completed. Accordingly, the discussion will now turn to environmental decisions made by business firms. The next chapter will present a conceptual framework for such decisionmaking; it will be followed by a case study of the environmental control actions of an actual firm.

VI. DECISIONMAKING BY FIRMS:

A CONCEPTUAL FRAMEWORK

The preceding three chapters of this dissertation dealt with the environmental decisions of government agencies and included descriptions of models useful for economic analyses, a theoretical approach to decisionmaking (benefit-cost analysis) and an empirical look at an actual agency. Now the subject will turn to the nature of decisions made by individual firms. In a very real sense, this analysis falls within the general structure developed in the past three chapters: decisions, both accomplished and anticipated, of government agencies comprise a large subset of the constraints facing business managers. For this reason, both the nature of governmental decisions and the ways in which they are reached must be considered explicitly by decisionmakers at the firm level.

This chapter will discuss, in turn, the kinds of decisions that must be made by firms, the informational needs and difficulties that surround such decisionmaking, and alternate organizational arrangements for making environmental decisions. The next chapter will comprise a study of how a particular firm, an electric utility, has actually gone about deciding environmental questions. The specifics of that real-life situation will be linked to the general considerations that will already have been discussed in this and preceding chapters.

An Overview of Environmental Decisions of Firms

In general, a firm must make decisions concerning (1) its overall strategy toward compliance with environmental regulations, (2) the selection of methods to achieve compliance in specific situations, and (3) managerial control of environmental projects. Since all of these decisions are predicated upon the firm's underlying goals, some attention must now be given to just what the firm seeks to accomplish. While there has been much debate on this topic, it seems reasonable to assume that the behavior of the management of most firms is at least consistent with long-run profit maximization subject to the perpetuation of the "management group." Although it is not, strictly speaking, an articulation of the actual goals of managers, this statement can serve as a useful reference point for discussing managerial decisionmaking.

Determining an Overall Strategy toward Compliance

If it seeks to pursue a coherent disruption-abatement policy, a business firm must first choose the "level of compliance" with regulations that it will seek to achieve. However, since government can force compliance to any desired extent through specific standards, some attention must be paid here to what are the appropriate, relative responsibilities for

both government and corporations.

Corporate versus governmental responsibility.--As a starting point it seems clear that government must formulate the overall policy. The Research and Policy Committee of the Committee for Economic Development has stated that

. . . government's basic role through the political process is to determine the nation's goals, set the priorities, develop the strategies, and create the conditions for carrying out the work most effectively to the satisfaction of the public.¹

Here the term "government" seems to refer to the national level. However, all levels and branches of government share responsibilities for policy-setting. More specifically, local and state governments must formulate policies that are consistent with broader policies established at higher levels. In order to be made operational, these government policies must be translated into specific regulations and requirements. Crucial conditions for effective participation by private firms in the attainment of social goals would seem to be that the government promulgate standards that are both unambiguous and

¹Social Responsibilities of Business Corporations (New York: Committee for Economic Development, 1971), p. 51. Since the CED is widely regarded as an organization that reflects the broad middle of the spectrum of social-political views held by American businessmen, this publication represents an important statement of the contemporary attitudes within the private, producing sector. Notwithstanding the prestige of this organization, many businessmen would express a personal point of view that would be either more conservative or more liberal. The "Memoranda of Comment, Reservation or Dissent," included at the end of the CED booklet provide some insights into this diversity of views.

consistent with each other, and that the standards remain relatively stable over time.

Three levels of corporate responsibility.--The different views of corporate social responsibility may be usefully classified into three broad categories: strictly limited, limited, and broad. These categories correspond in a general way to the "concentric circles of responsibilities," as outlined in the CED's Social Responsibilities report, which comprises the public's "expectations of business" for contributing to a good society.² The level of strictly limited responsibility allows only for compliance with specific regulations and hence corresponds to the "inner circle" of responsibilities that "includes the clear-cut basic responsibilities for the efficient execution of the economic function--products, jobs, and economic growth." The level of limited social responsibility allows for "good faith" in following government policy, but goes beyond mere compliance with the letter of the law. For instance, this level of responsibility would have a corporation avoid stalling in the implementation of pollution control devices. It would require a firm not to exploit the lengthy legislative and judicial processes.³ This second level is related to (but not coincident with) the "intermediate circle" of responsibilities

²Ibid., pp. 15-16.

³An example of such stalling might be the following: A firm knows an environmental regulation calling for control of emitted particulate matter will be implemented soon. The firm tries to temporarily increase its production and build up its product inventories prior to the deadline.

that "encompasses responsibility to exercise the . . . social function with a sensitive awareness of changing social values and priorities. . ." The boundary between this middle level and that of broad corporate social responsibility is not at all precise. However, the broad level would mean that the firm takes action to improve social conditions of its own volition. Such action is motivated neither by existing regulations nor by the expectation of future regulations, future damage claims, or future benefits which would accrue to the firm. This last level of corporate social responsibilities corresponds to the "outer circle of responsibilities" articulated by the CED report. That committee's comments on such broad corporate activities are of particular importance due to the CED's widely perceived role as a spokesman for American business in general;⁴

Society is beginning to turn to corporations for help with major social problems such as poverty and urban blight. This is not so much because the public considers business singularly responsible for creating these problems but because it feels large corporations possess considerable resources and skills that would make a critical difference in solving these problems. Indeed, out of a mixture of public frustration and respect for the perceived efficiency of business organizations, there is a clear tendency to look to corporations to take up the slack resulting from inadequate performance of other institutions, notably government but also education and health care in some measure. At the same time, the weight of informed opinion seems to be that these tertiary areas are not the responsibility of business in the first instance but that of the public sector and/or other private institutions. Even so, there is growing support for a more self-conscious partnership between business, government, and other institutions in some of these areas, most of all in urban affairs.

⁴ See footnote 1, above.

These broadened expectations of business have been building up for some time. This is indicated by the trends in public opinion over a number of years, and by the resultant actions of government in responding to the public will through an increasing variety of measures to protect consumer interests, to clean up the environment, and to enhance equal opportunities for employment and career development in industry. The evidence strongly suggests that these are solid and durable trends, not momentary frustrations or fads, and that they are likely to increase rather than diminish in the future.

Public opinion trends, of course, are not the only criterion for formulating sound business or public policy. Yet public opinion is a basic consideration, and in democratic society it usually is determinative over the long run, as demonstrated throughout the history of American business.⁵

One way in which public opinion influences corporate behavior is described elsewhere in the CED report:

There is increasing understanding that the corporation is dependent on the goodwill of society, which can sustain or impair its existence through public pressures or government. And it has become clear that the essential resources and good will of society are not naturally forthcoming to corporations whenever needed, but must be worked for and developed This body of understanding is the basis for the doctrine that it is in the "enlightened self-interest" of corporations to promote the public welfare in a positive way.⁶

To those who would claim that the objective of a corporation is to serve the best interests of its stockholders rather than the broader interests of society, the CED committee counters with the following:

. . . the widely diversified nature of business

⁵Ibid., pp. 15 and 16. Emphasis added.

⁶Ibid., p. 27.

ownership today alters the interest of the stockholder as classically defined. . . . Stockholders' interests . . . tend to ride with corporations as a group and with investment policies which provide benefits to the corporate sector as a whole--in the form of improved environmental conditions, a better labor force, and stronger public approval of private business. That is, corporations as a group--and singly as well, under reasonable assumptions--will earn more on their invested capital, and stockholders will be better off if these broader investment policies are adopted.⁷

The scope of corporate social responsibility: an evaluation.--The comments from the CED report indicate that the business community tends to accept social responsibility to more than a strictly limited degree. It is not clear, however whether corporations in general accept a limited or a broad degree of social responsibility. Furthermore, acceptance of general social responsibility of even a broad degree does not imply that a specific firm or the corporate community in general accepts any more than strictly limited responsibility in a particular area, such as minority hiring, pollution, or work safety.

Notice, too, that given appropriate government policies and procedures, the strictly limited and limited levels of corporate social responsibility could be made to converge. In other words, the range of corporate social responsibility needed to meet public goals can be further limited if the government provides a degree of retroactivity in its legislation, vigorously pursues lawsuits for damages caused by a firm's pollution, and encourages private lawsuits under specific statutes or under a

⁷Ibid., p. 30.

"nuisance" theory.⁸

Finally, mention must be made of the dangers inherent in wide acceptance of very broad corporate social responsibility. There is some danger of public decisions being made in the private producing sector: broad social responsibility, carried to excess, could lead to a form of "corporate-big-brotherness" wherein public policy is determined by private firms. Moreover, the viability of our economic system could conceivably be threatened if the efforts of firms were to become so diverted into providing for the public good. Clearly, a balance must be struck between governmental and corporate responsibility.

Choosing a "level of compliance."--With this discussion of government versus corporate responsibility serving as a background, attention may now return to the decision that must be made by a particular firm. If it chooses to accept "strictly limited" responsibility, the firm must further decide whether to comply merely with existing regulations, strictly interpreted, or with both existing regulations and anticipated, future ones as well (although, again, the attempt would be made to comply only with the expected "letter of the law"). An alternative selection would be to comply in a manner consistent with "limited social responsibility," that is, going beyond statutory requirements as strictly interpreted but stopping short of taking "voluntary," unilateral action to improve social conditions

⁸ A description of several suits brought under a nuisance

without reference to any existing or anticipated legislation. The latter approach would instead constitute compliance at the level of "broad social responsibility."

Numerous considerations, many of which could be highly individualized to a particular industry or firm, are involved in the selection of a general strategy for compliance. Perhaps primary among these factors are the specific goals of the firm's management. Although it was suggested above that firms tend to act in a manner consistent with long-run profit maximization, firms are likely to have some diversity in their actual goals. Another consideration might be the firm's ability to forecast future abatement regulations. Certainly, this capability or the lack of it would heavily influence the choice whether to comply with anticipated regulations in addition to current ones.⁹

Also influencing the choice of a strategy would be the firm's sensitivity about its public image: the more sensitive the firm, the higher the level of overall compliance that it will deem necessary, ceteris paribus. Concern over public image may

theory is contained in Steven C. Dilley, Accounting for Externalities: Conducting a Social Audit and Preparing a Social Responsibility Annual Report for a Public Utility, unpublished doctoral dissertation, University of Wisconsin--Madison, 1972.

⁹Note that a recognized inability to make accurate predictions may lead either to attempts to comply with future regulations or to avoidance of any such attempts. For instance, a firm may choose not to comply with future regulations simply because it has no idea what they may be like. Conversely, a firm may attempt "to comply" with future regulations by expanding abatement beyond the currently-required levels, because it cannot assess the likelihood of current control standards being maintained in the future!

itself stem from a wide array of causes. One of these surely is marketing considerations, in terms of the firm's perceived degree of dependency of its sales volume on consumers' attitudes toward the firm's abatement efforts (in conjunction with the perceived relationship between such consumer attitudes and actual abatement efforts by the firm). Firms in the so-called "regulated industries" appear to have a heightened awareness of their public image. Such an attitude may stem either from the individual firm's feeling of responsibility because it has a monopoly franchise to provide a necessary service to the public or from its perception that the regulatory agency holds such an opinion. Similarly, any large, producing corporation may have an increased sensitivity to its image because it feels there is some possibility that the governmental agency overseeing disruption-abatement will single it out as a "showcase" example. All the aforementioned considerations are closely linked with the firm's physical location. A firm that is highly visible because of its location in a densely-populated area or the unusual nature of its operations (relative to its location) would be inclined to be more concerned over its corporate image than if it were in an "out-of-the-way" location or if it were merely one of many, "similar" firms.

Other factors commonly influencing a firm's selection of its scope of compliance would include the background of its top-level managers, the composition of its board of directors, and demographic characteristics of its stockholder group. In addition, a corporation's previously-demonstrated policies in

such other areas of "social concern" as on-the-job safety and minority hiring influence its attitude toward disruption abatement: a firm may seek to compensate for a poorly-received showing in some other area, it may wish to maintain a consistent policy in all areas of social concern, or it may feel that a well-received policy in some other area lightens its burden for disruption-abatement.

Implications for reporting.--Upon considering the wide range of factors underlying a corporation's selection of a general plan for compliance with abatement regulations, it becomes readily apparent that the ultimate motivation for such a decision cannot be determined with much reliability or meaning by an outside observer. Indeed, many managers would admit, with apparent sincerity, that they cannot pin down their own motivation. Psychological testing could, perhaps, be used to discover whether a particular manager's decisions were predicated upon his personal best interests, those of his firm, or an altruistic attitude toward corporate, social responsibility. It is quite debatable whether the results of such tests, assuming results could be obtained, are the stuff of which meaningful reports could be constructed for persons needing to make decisions concerning environmental matters. In this same vein, the identification of an "anticipated, future regulation" is often quite elusive. Accordingly, whether a firm is voluntarily going beyond anticipated regulations often cannot be determined unambiguously. Such considerations imply a need for a firm to

disclose the environmental regulations affecting it, its own goals for abatement, and its efforts to attain those goals. Such disclosure would enable statement users to make comparisons with other firms in the same industry or locale, of a similar size, with comparable disruption problems, or with similarly-expressed commitments to abatement. Users could thus draw their own conclusions concerning the appropriateness of the firm's level of compliance.

Selecting Specific Approaches to Compliance

Fundamentally, most decisions concerning the specific methods to be employed to achieve the accepted level of compliance can and should be handled within a capital budgeting framework. Since this methodology has been presented in the literature in a highly-refined fashion, and since the net-present-value version of capital budgeting is essentially equivalent to the benefit-cost model described in Chapter IV, there is little reason to present a specific formulation here.¹⁰ However, some of the special considerations involved in applying capital budgeting techniques to environmental decisionmaking should now be outlined. The informational needs implied by these considerations will be discussed in a subsequent section.

¹⁰ An excellent treatment of this subject is contained in Harold Bierman, Jr. and Seymour Smidt, The Capital Budgeting Decision (Third Edition; New York: The Macmillan Company, 1971).

Since the overall decision criterion under this model is either "profit" maximization or "cost" minimization, the firm must organize the factors affecting its decision into goals and constraints. The firm's chosen level of compliance is relevant here, for acceptance of "broad social responsibility" would seemingly imply that the firm views compliance as a "goal" or, in a broad sense, one component of the "profit" that is to be maximized. Conversely, rejection of such responsibility would indicate that the firm views compliance as a "constraint": the alternative selected must meet minimum standards for compliance.

After articulating goals and constraints, the decisionmaker must proceed to evaluate individual costs and benefits that pertain to the goals. Here numerous difficulties may be encountered, such as those pertaining to the estimation of the capital and operating costs of various abatement devices. Similar problems abound in the measurement of benefits and in the specification of certain benefits (and intangible costs as well). Many of these complications become particularly apparent when alternate control methods are investigated. For example, circumstances might require the comparison of an expensive, add-on abatement device with a change in fuel type or with a fundamental change in the production process. Each alternative might well imply a different operating efficiency and scale. In such a setting, separating-out the differential effects of various abatement methods becomes a far-from-trivial undertaking!

The information needed for capital budgeting decisions, and the problems that may be encountered in obtaining it, will

be studied later in this chapter.

Managerial Planning and Control

While the need to anticipate changed conditions and to budget available resources adequately is always a prerequisite to good managerial performance, the fast-breaking and uncertain nature of disruption abatement necessitates a special emphasis on comprehensive planning. In particular, since environmental-quality-control is still in its "premature" era, a firm must plan carefully to retain options in its approach to compliance. Becoming overcommitted to a specific control method could portend disaster should future circumstances vary from their expected patterns. With all the potential sources of uncertainty--to be detailed presently--that surround environmental decisions, many firms no doubt find it crucial to maintain flexibility.

In order to proceed efficiently with disruption abatement, firms must remain alert to impending changes. These include changes in conditions of nature, public tastes, and, most importantly, specific regulations. Managers must delineate the types of information and the reporting practices needed to develop an "early-warning-system" for imminent changes. Similarly, managers need to review past decisions to see if the underlying analyses were valid and whether the control program is working as anticipated. A general system of performance review is required in order to assure the feedback, of information concerning operating results, that is so vital to the timely revision of the firm's analytical decision-models and abatement

technology.

Information Needs and Problems

The past several pages examined the different kinds of environmental decisions that firms must make. Now, attention will be given to the types of information required by the decisionmakers and to the problems that complicate the task of information gathering.

Cost recoverability.--The tangible costs of disruption control, including both capital and operating costs, are essential considerations under capital budgeting but they are often hard to estimate. It must be remembered, however, that it is the prospect for recovery of such costs through revenues rather than the size of these costs per se that is of basic concern to the manager. Thus, the question of cost recoverability breaks down into questions concerning the size of an expenditure and the identity of the economic unit or units who must bear its burden.

Control costs are difficult to forecast for various reasons. Pollution abatement, to a considerable extent, depends on technology that is either new or has not been tried on a large scale. Accordingly, it is difficult to predict, with great precision, the costs of control equipment and services. Moreover, problems of forecasting abatement costs are complicated by many other types of uncertainties that will be discussed below.

The question of who will actually bear the burden of abatement costs is difficult to answer. Certainly, the effect

of public opinion on cost recoverability is likely to be significant, due to the impact of public opinion on government policies and customer loyalty. Yet, the attitudes of consumers, regarding payment for pollution control, are hard to predict.

Laws and administrative regulations of various governmental units which do not deal primarily with environmental quality also bear heavily on the question of cost recoverability.

For instance, the tax treatment afforded different, and perhaps alternative, abatement costs has a considerable impact on the true cost of such expenditures to the firm. Rapid depreciation of abatement equipment for tax purposes reduces the effective costs of that equipment to the firm and this enhances the likelihood of cost recoverability. Similarly, the relative treatment afforded capital versus operating expenditures can greatly bias the selection of an abatement method. Furthermore, the existence and "style" of various regulatory agencies such as state public service commissions, the Federal Power Commission and the now-defunct Phase IV Price Commission indirectly condition abatement decisions. A utility rate-setting agency, for example, may be prone to accept one type of expenditure over another for inclusion in a firm's rate base. Accordingly, the utility may find it necessary to reorder its preferences among alternative abatement methods. Similarly, general controls over profit margins may contribute to a manufacturer's willingness to install control devices and may influence his choice among methods insofar as their expense patterns over time are different. Such alternative expense

patterns may also become a decision criterion when the firm feels it must consider the differential impacts of various controls on the financial statements and the users of them.

Availability of funds.--The other side of the cost-recoverability question concerns the potential sources of the funds to be spent. What sources are actually available depends on all of the public policies discussed previously, and on general economic conditions and specific investor attitudes as well. Furthermore, it does not seem reasonable to believe that any of these factors are independent of one another or of the many additional, general sources of uncertainty.

The problem of joint costs.--One common difficulty inherent in any incremental analysis, and particularly pertinent to environmental decisions, is the occurrence of joint costs. To cite but one example, an automobile manufacturer has claimed that the catalytic converter will lead to an increase in gasoline economy.¹¹ Thus, counting the entire cost of the converter as an abatement expenditure would amount to inflating artificially the incremental cost of improved environmental quality. An even more difficult measurement problem arises when a firm builds a new plant embodying new technology for several reasons, such as increased efficiency, worker safety, air pollution abatement,

¹¹Douglas Williams, "Device to Cut Car Fumes Called Unsafe in U.S. Study, " Detroit Free Press, October 17, 1973, p. 6-A.

and scenic quality. In this setting, the optimal approach to decisionmaking--assuming the cost of the decision process is immaterial--would be to compare all feasible "total configurations for operating activity." Obviously, such a decisionmaking strategy would be far from costless. Still, some sort of systems approach is definitely called for, due to the presence of so many interrelated factors--costs, benefits, and constraints. Even though it is probably not feasible to compare all "total configurations," this general frame of reference can be used to avoid serious errors that might otherwise result from some narrower perspective.

Effectiveness of control measures.--A key question in reaching any decision concerning abatement techniques is whether a given method will perform as expected. This question may be decomposed into three inter-related segments. First, the link between emission levels and the ambient quality of the related environmental "sink" is quite imprecise. Dispersion equations have been developed to relate a given emission rate to an ambient concentration of pollution at some later point in time and perhaps at a different location as well. However, these equations are far from perfect. For the most part, atmospheric dispersion is the concern of government decisionmakers: nearly all environmental regulations are cast in terms of either emission rates or input standards, not ambient quality.¹² However, in a

¹² While regulations in terms of ambient quality might present some advantages from the standpoint of economic efficiency, they may not be practicable in many instances.

setting where one particular firm (or group of firms) agrees that it is the primary source of a certain type of disruption, it may be feasible for that firm to press for regulation in terms of the ambient concentration of the pollutant rather than its emission rate.

The second cause for concern over effectiveness of control methods is the relative newness of abatement technology, as was mentioned earlier. In a setting where a specific control method is first implemented, its operating efficiency and effectiveness normally cannot be predicted with the precision possible in the case of tried-and-true techniques. While much of the abatement technology is quite new, a great portion represents, instead, the application of well-tested techniques on a newly-expanded scale. Here, too, prediction is difficult since the operating characteristics of control technologies may vary significantly with the scale of operations.

A third problem in estimating the effectiveness of control techniques is the possible generation of "side effects." Perhaps the most glaring examples of this difficulty have appeared in the attempts to control automobile emissions. For example, the techniques used in the late 1960's to reduce hydrocarbon emissions actually worsened the problems with nitric oxides. More recently, the catalytic converter, heralded by some as the only viable means for domestic automobiles to meet the stringent 1975

For example, it may be inordinately difficult for a regulating agency to assess relative shares of guilt among many firms in the wake of a severe smog episode.

standards, has been discovered to cause emission of sulfates, a potential health hazard.¹³ These "side effects," along with the newness of abatement technology and the imprecise link between emission rates and ambient conditions pose serious uncertainties for the environmental decisionmaker.

Future problems are unknown .--At a given point in time, the corporate, environmental decisionmaker faces a set of existing disruption forms and their corresponding standards, actual and potential. In addition, he faces the prospect that new forms of disruption will be identified in the future or that the seriousness of currently-specified pollutants will be discovered to have been inaccurately assessed. Could the decisionmaker foresee such future considerations, he might well make decisions that would differ greatly from those he makes given existing information alone. Realistically, future "discoveries" of this sort are not amenable to prediction. Accordingly, they become yet another source of uncertainty in environmental matters.

In general, future problems will be articulated for any of three reasons. First, scientific research may lead to the conclusion that a given condition constitutes a disruption problem or that a particular pollutant is either more or less dangerous than previously supposed. Second, changing tastes,

¹³ "EPA Holds to Rules on '75 Autos Despite Questions on Catalyst," Wall Street Journal, November 7, 1973, p. 12.

attitudes toward regulation, and levels of awareness among the public may bring demands for new types or increased stringency of disruption controls. Third, new types of activities, the expansion of certain types of existing activities, or changes in physical conditions may lead to new forms of disruption or may turn an incidental and unimportant kind of disruption into a full-fledged problem.

Such consideration of the levels of control that will be required in the future leads once again to the question of what will be the relative emphasis on the two, basic, macro approaches to disruption regulation: maintenance or improvement of the ambient qualities of environmental "sinks" or, alternatively, achievement of a specified emission rate for each of many pollutants. A wrong guess concerning the key direction of governmental policy, combined with the capital-intensive nature of many control strategies, could prove tremendously costly to a business firm.

Future conditions.--Closely linked to the question of future regulations is the uncertainty surrounding the state of future social, economic, and physical conditions. Future circumstances will depend on such factors as

- (1) The overall level of economic activity as well as the characteristics and relative sizes of the component sectors of the economy.
- (2) Population size and dispersion.
- (3) Land use patterns
- (4) Abatement actions already undertaken, including those related to the disruption form of concern to

the particular firm as well as those pertaining to all other forms.

(5) Climatic changes

A considerable amount of uncertainty is inherent in estimating any of the above factors. In total, these considerations present still another, serious complication for a firm that must make environmental decisions.

Reducing uncertainty.--At first glance, it may seem that the situation facing a business manager is hopelessly uncertain. However, it must be remembered that the function of information is "to reduce uncertainty about the actual state of affairs of concern to the user."¹⁴ Accordingly, each of the sources of uncertainty examined above implies a need for information. Even though the decisionmaker will never be able to eliminate uncertainty, in general his decision will be improved by the availability of information that is as relevant and complete as possible.

Who Makes Environmental Decisions?

The just-completed discussion of the nature of and the information required for environmental decisionmaking by

¹⁴Committee to Prepare a Statement of Basic Accounting Theory, A Statement of Basic Accounting Theory (Evanston, Illinois: American Accounting Association, 1966), p. 8.

firms leads naturally to a consideration of who within the organization should be responsible for making what environmental decisions. Due to its broad and long term nature, overall strategy-setting should clearly be the task of the top-level managers of a firm. Certainly, if environmental concerns are at all material to a firm, this authority cannot appropriately be delegated beyond the vice-presidential level. Indeed, for many firms environmental questions are so important that the board of directors or a subcommittee thereof may reasonably become involved in strategy determination. While these decisions should be the province of upper-echelon management, staff assistance on a substantial scale should not be precluded.

Once the firm's essential policy for coping with environmental aspects of its operations has been settled, most of the decisions related to selection of specific control methods are of an operating nature and hence can be delegated to divisional and plant managers. Yet, due to ramifications of disruption and abatement which go beyond the limits of a single division or plant, some type of company-wide coordination may still be desirable. Such coordination could be achieved by formally charging a "line" vice-president with general responsibility for the abatement decisionmaking of his subordinate divisions. Alternatively, an environmental "staff" department could be created to handle this coordination; the head of such a department could hold "functional" authority over plant managers in the area of environmental decisionmaking. In most cases, it might be supposed, some combination of "line" authority wielded by a

superior manager and "functional" authority vested in a staff executive would be employed.¹⁵

Some general, empirical evidence concerning the role of the environmental disruption control manager is available. A report published by the Conference Board examines a group of 89 firms that, by the late 1960's, had given special organizational emphasis to pollution control.¹⁶ In particular, the study provides some generalizations about the location of the pollution control executive within the firm and the scope of his responsibilities. This manager is generally placed within a manufacturing department, an engineering group, or, less frequently, the research department. Of those firms placing this function within manufacturing, two-thirds locate it in a production-related area and one-third position it in a plant or technical services department. When located within engineering, the pollution control function may be set up as a special unit or else fully merged with other engineering duties.¹⁷

Another aspect to the structuring of the disruption abatement function concerns supervision. Most often, the pollution control officer reports to a staff manager within some functional area, typically an engineering manager but sometimes

¹⁵These various types of authority are discussed in Charles T. Horngren, Cost Accounting, (Third Edition; Englewood Cliffs, N. J.: Prentice-Hall, 1972), pp. 10-11.

¹⁶Richard A. Hopkinson, Corporate Organization for Pollution Control (New York: The Conference Board, 1970).

¹⁷Ibid., pp. 4-6.

a manufacturing or technical services manager. The next-most-common supervisor is a staff vice-president of a specific, functional area such as manufacturing, engineering, or research. Some firms have the pollution control officer report to a group vice-president and several others have him report to the firm's president.¹⁸

The duties of the typical pollution control manager may be classified as being either technical or administrative. Technical duties include such things as the coordination of abatement activities among the units of the firm, measurement of disruption and abatement-effectiveness, and research into control techniques and the design thereof. While all of these responsibilities may be viewed as being "staff" in nature, the pollution control manager in some firms is given certain "line" authority as well. Examples of such authority include responsibilities for program implementation, review of abatement plans (this may be a "staff" function if the manager only sends his recommendations to a higher-level executive), and equipment selection. Administrative duties comprise, most commonly, coordination of pollution-abatement with overall company goals and government relations, but there are many other such responsibilities assigned in some firms.¹⁹

¹⁸ Ibid., pp. 13-14.

¹⁹ Ibid., pp. 19-24.

Summary

This chapter presented a conceptual description of the environmental decisions made by business firms. Presumably, the behavior of a firm can be explained as an attempt to maximize profits over the long run while perpetuating the existence of the "management group." In accordance with such underlying goals, the firm must choose the "level of compliance" with environmental regulations that it will seek to attain. Then, using a capital-budgeting approach, the firm can proceed to select specific methods for abating disruption. In order to maintain managerial control over environmental projects and to keep abreast of impending developments, the firm must develop a formal planning system.

The manager faces many uncertainties in making environmental decisions. However, the more relevant and complete the information that he has available, the better his decisions are likely to be.

While determination of a firm's "level of compliance" with regulations seems to be an appropriate function for its top executives, development of specific abatement programs should be delegated to divisional or plant managers. A research study commissioned by the Conference Board provides some generalizations about who makes environmental decisions in practice.

In order to provide some empirical support for the concepts presented above, the next chapter will investigate the actual environmental decisionmaking of a large utility firm. In the concluding chapters, both the conceptual notions and the empirical findings will be used to specify the scope of the accounting function as it pertains to environmental decisionmaking and reporting by firms.

VII. AN EMPIRICAL STUDY OF CORPORATE DECISIONMAKING

The preceding chapter outlined the ~~general~~ context within which environmental decisions must be made by business managers. In this chapter, the actual environmental decisionmaking of a specific firm will be described. The factual content of this discussion is based primarily on "in-depth" interviews conducted with both accounting and environmental managers from the firm which, in order to preserve its anonymity, will be called "Midwest Utility." It may be noted, however, that this firm is a large electric utility that has constructed and operated both conventional and nuclear plants.

The plan of this chapter.--In keeping with the ~~general~~ format of the preceding chapter, this study will begin by examining Midwest Utility's overall attitude toward disruption ~~abatement~~. Three pertinent topics will be covered: (1) those characteristics, peculiar to utilities, that bear upon this firm's environmental decisions; (2) the historical development of abatement techniques by this firm; and (3) the firm's management structure for environmental decisionmaking.

With this general context in mind, a close look will be taken at the specific method by which Midwest Utility reaches decisions about environmental projects. First, the basic

assumptions and uncertainties voiced by managers at the firm will be reviewed. Then, an example of the application of the decision-model will be described. In the particular situation in the example, Midwest Utility had to decide upon particular ways to comply with regulations concerning sulfur oxides (and other pollutants as well). Conceptually, then, this section will link to the discussion in Chapter V of the efforts of government agencies to develop emissions limits for sulfur oxides. Next, a critique of the firm's decision-model will be presented.

The final section of this chapter will consider the information Midwest Utility needs for environmental decisions and reports. The firm's accounting system, a major source for such information, will be described in some detail. Finally, the ways in which information needs and sources may be matched will be investigated.

Overall Attitude toward Abatement

Special Characteristics of Electric Utilities

Before attempting to describe the environmental decision-making of Midwest Utility, it is appropriate to examine those general characteristics of utilities that bear upon such matters. One reason for including these prefatory remarks is that certain of the environmental problems confronting utilities and some of the actions taken by utilities in response may reflect significantly the peculiarities of these firms. To the extent that this

relationship is actually present, observations concerning the utility studied can be generalized only with caution.

Primary pollution problems.--In general, electric utilities are most concerned with air pollution, particularly the emission of sulfur oxides resulting from the burning of fossil fuels. In many urban regions, the local electric utility is the largest source of the emission of sulfur oxides, due to the use of relatively high-sulfur, eastern coal. In addition, particulates may pose serious problems for such firms. Electric utilities do not, in general, have significant troubles with water pollution, with the exception of thermal pollution resulting from the use of water for cooling purposes and its discharge into a lake or stream. However, while public concern over thermal pollution is often significant, scientific studies have given ambiguous results about the resulting damage to the aquatic ecology.¹ Noise and scenic pollution, the latter usually related to above-ground wires, are additional environmental concerns of electric utilities.

Physical location.--Typically, the electric utility has its operations located either within or closely adjacent to population centers. Administrative offices, generating plants,

¹Steven C. Dilley, Accounting for Externalities: Conducting a Social Audit and Preparing a Social Responsibility Annual Report for a Public Utility (Unpublished doctoral dissertation, University of Wisconsin-Madison, 1972), p. 109.

and substations are generally in highly-visible locations, thus keeping the firm and many of its pollution problems in the public eye.

Regulation.--The fact that electric utilities have their rates set by government regulators affects their environmental decisionmaking in two general ways: cost recoverability and public image. In general, the analysis of cost recoverability for utilities includes some considerations that do not apply to non-regulated firms. Since the utility is allowed to charge rates which afford it a particular rate of return on an appropriately-defined asset base, whether a utility can recover the cost of a particular type of pollution control may indeed amount to a question concerning the likelihood that the regulatory agency will consider that cost allowable in rate-setting. Of course, this line of reasoning should not be carried to excess. Overall, the demand for electric power in the long run is not inelastic. Hence, even with the concurrence of the regulators, a utility may not be able to raise its rates by a sufficient amount to recover the control cost, due to a reduction in the amount of electricity it can sell at increased rates. Nonetheless, the attitude of the regulatory commission certainly is relevant to the environmental decisionmaking of a utility.

A second special characteristic of a utility is its monopoly franchise. Utilities are keenly aware that consumers usually have no feasible, alternative source of electrical energy (although substitute energy forms may be available). Be it from a beneficent attitude towards its customers, the fear

of adverse reactions from the public or the regulators, or, most likely, some combination of both, utilities generally express a great deal of public spirit. In short, the managements of utilities are especially sensitive to their firms' public images, largely due to the monopoly franchises held by their firms.

Who should benefit?--For a regulated utility, the question of precisely who should receive the benefit from and who should pay for an environmental improvement assumes particular importance. The typical disruption control confers benefits upon but a portion of the general public. As an example, consider the undergrounding of utility wires, one type of improvement that is becoming increasingly common. Obviously, the benefits from such a change would accrue primarily to residents of those neighborhoods where underground wires are installed. Now, there are at least three different ways in which the costs of undergrounding could be covered. First, the costs, both capital and operating, could be treated in ordinary fashion, which would amount to spreading the cost over all customers of the utility. Certainly, such treatment would violate horizontal equity.

A second method to recover undergrounding costs would be to charge customers in the affected neighborhoods a differential rate. At least superficially, such an approach would appear to be the most equitable and the most efficient, but upon closer inspection, certain conceptual difficulties appear. Individual

customers will not be able to select between above-ground and underground service, while much of the cost of undergrounding will be joint to the service of an entire group of customers. Moreover, determination of the differential rate may not be clear-cut, since a large portion of the costs may be of a capital nature.² Such theoretical ambiguities as these cast serious doubts upon the efficiency and equity of the differential-rate approach.

A third possible method might be to have the local government pay the capital costs of undergrounding. This action would be considered a "contribution in aid of construction," and both the cost of construction and the contribution would be recorded. As a result, the utility would face higher property taxes. Again the question of who will pay would arise.

Undergrounding is but one example of an abatement expenditure that might raise the issues of who should benefit and pay. However, the above discussion should demonstrate that, for a utility firm, public regulation further complicates environmental decisionmaking, which is undeniably a wide-ranging and multi-faceted challenge for any firm.

²Here, however, one might suggest that the differential rate be split into two parts, one relating to operating costs and the other based on the utility's allowed rate of return applied to the capital costs. Problems still remain, because individuals use varying amounts of electricity. Yet, this approach would make it possible to develop an overall charge for the neighborhood.

Early Efforts at Control

The study of Midwest Utility will begin by tracing its development of abatement methods over a long span of time.

Motivation for control.--Many years ago, industrialists considered the emission of smoke from a factory to be a healthy sign of a prospering firm and economy. However, even quite early in their histories, electric utilities realized that particulate emissions contained in such smoke represented, in fact, wasted energy. In the early 1920's, Midwest Utility began to investigate such improved combustion techniques as better stoker methods and the use of pulverized coal. Along with the problem of inefficient fuel usage, electric companies faced the difficulty of having to continually change their rate of production in step with varying customer demand. This latter problem, one that continues to plague utilities, led to the development and implementation of automatic control devices. Midwest Utility first began to use such devices during the 1940's.

Prior to the current era of pollution regulation pursuant to the passage of the Clean Air Act of 1963 and its subsequent amendments, this firm had eliminated the emission of smoke during periods of normal operation in those of its plants that incorporated the latest technology. However, due to the very long life of electricity-generating plant assets, a lengthy period typically passes from the time of development and initial

installation of a new method until that method becomes the one utilized for most production. Thus, while the firm had the technological capability to eliminate smoke emissions from normal generations, such abatement was not in operation at all of its plants.

Pulverized fuel.--As mentioned above, the use of pulverized coal was one technique electric utilities turned to in order to increase their generating efficiency. Unfortunately, this fuel causes pollution woes: all of the raw fuel is crushed, including some non-combustible matter. The residual material from the combustion process, known as fly ash, gets carried along with the stack gases. These serious particulate problems were attacked by using electrostatic precipitators, devices that electrically charge and trap particles which are suspended in the stack gases. First used by Midwest Utility in the mid-1920's, the early electrostatic precipitators operated with an efficiency of about seventy to seventy-five percent. The efficiency of these devices did not exceed seventy-five to eighty-five percent through the 1940's, due to the inability to control operating voltages more accurately. As the technology of electronics became increasingly sophisticated, first vacuum tubes and then semi-conductors were used to control voltages. Increased efficiency of precipitators resulted.

By the mid 1940's, the typical, new, electricity-generating plant utilized large boilers, fired by pulverized fuel, in conjunction with large precipitators. Late in that

decade, mechanical dust collectors, which remove particles suspended in fluid, began to be used jointly with the precipitators. This entire process has been developed to the point where it is today more than 99% effective in eliminating particulates from the stack gases.

Administrative Arrangements for Environmental Decisionmaking

Midwest Utility created a specific post for an environmental manager in 1968. Prior to that time, an assistant engineering manager had been assigned the duty of overseeing the firm's environmental efforts. However, since that individual had been spending virtually all of his time dealing with environmental affairs and due to the increasing importance and complexity of such activities, the need for a full-time environmental coordinator became readily apparent. The environmental manager reports to the manager of planning and research who, in turn, reports to the firm's vice-president for operations. This last-mentioned individual reports directly to the president (and chief executive) of Midwest Utility. The person now serving as environmental manager is a chemical engineer by training and has functioned in staff managerial positions for almost ten years. He directly supervises three people: a graduate engineer, who is also a lawyer; a mechanical engineer, who previously served on the management staff of one of the firm's largest power plants; and a clerical and secretarial assistant. In addition, the environmental manager has available

to him and has utilized general staff personnel located throughout the firm.

As for the specific duties of the environmental manager, Midwest Utility's own internal documents state that

"The appointment of an environmental manager recognizes the need to centrally coordinate all Company environmental efforts and costs. This manager will be responsible for coordinating the work of all departments in the Company which are developing and implementing plans for complying with and guiding environmental regulations of all kinds, including air, water, noise, and land use. This responsibility will also involve anticipating future environmental requirements and promoting appropriate voluntary actions to minimize the impact on the environment resulting from the Company operations."

The environmental manager sees his department's essential responsibility of coordinating the firm's environmental efforts as comprising five steps: (1) to identify existing or potential problems; (2) to advise senior management with regard to policies that would address the problems and to obtain senior management's decisions; (3) to develop plans, or to see that such plans are formulated by other departments, for the implementation of management's policies; (4) to assist in the evaluation of alternative approaches towards solutions; and (5) to develop management reporting and control systems that provide the feedback needed to ascertain whether the plans and policies are being carried out effectively.

Other managers with environmental responsibilities.--While the overall coordination of Midwest Utility's environmental planning and implementation is vested in the environmental

manager, several other persons within the company have responsibilities in this area. The environmental engineering department handles scientific and technical studies related to environmental disruption and abatement methods. Also, the manager of each plant is charged with the responsibility to see that his plant operates in an environmentally-acceptable fashion. Indeed, the firm expressly considers the meeting of environmental regulations and, further, its own goals in this area as a major objective for plant managers.

Another individual having specific environmental responsibilities is the project manager for air and water quality control. To understand the nature of this position, one must realize that, for each major project--generally a construction projection of some type--Midwest Utility appoints a project manager. This person may be located in various places within the organization structure, but, wherever located, he serves as the focus for control over the project. The project manager of concern here reports to the manager of general engineering and construction who, in turn, reports to the vice president for operations.

A Systematic Model for Decisionmaking

The general setting for the environmental decisionmaking of Midwest Utility has been outlined in the preceding pages of this chapter. Faced with specific abatement requirements and a clearly-defined internal structure for coordination of its

environmental policies, the firm has developed a systematic procedure for selecting among alternative approaches to control. The justification for the use of such a model rests upon the firm's expressed acceptance of two basic premises. First, there is a definite need for disruption control. Second, environmental concerns loom so large that any inefficiencies in attaining the "proper" level of abatement are likely to be extremely significant in terms of the firm's "public image" and profitability.

Uncertainties.--Given these two assumptions, the requirements for a systematic decisionmaking methodology is made manifest by the large uncertainties that are involved. As has been pointed out several times before, these difficulties are, for the most part, common to all firms with environmental problems. Yet, the four considerations to be described below were explicitly mentioned by the manager for planning and research³ of this particular firm: these types of uncertainties apparently are considered to be the most relevant by the firm's management. The first such difficulty is the ambiguities contained in the environmental laws themselves. The key question is how will the allowable levels of disruption be defined over time? Perhaps foremost among all queries into what will be allowed is whether regulations will be cast specifically in terms of emissions limits or, instead, in terms of ambient quality of

³The present manager of planning and research was recently promoted from the position of manager of environmental affairs. As stated above, he supervises the current manager of environmental affairs.

the environmental sinks.⁴ A related question is to what extent intermittent controls will be allowed. The point is, of course, that continuous emissions limits are often much more costly to achieve than are intermittent limits required to protect ambient sink quality. For instance, during a period of thermal inversion a utility might turn on efficiency-lowering control devices, switch to a less-efficient or more-costly low-sulfur fuel, or even shut down a particular plant. During normal periods, higher levels of emissions might be tolerable. A wrong guess concerning what will be allowed in the future could be particularly costly for a utility because of the capital-intense nature of its operations. This characteristic forces the lengthening of the planning horizon for environmental decisions.

The nature and reliability of the fuel supply to be used at a particular plant is another cause for concern, made even more crucial due to the current energy situation. A key consideration is whether the fuel supply will be available for the lifetime of the plant.

A third source of uncertainty explicitly considered by this utility concerns regulation of its rates: will a given expenditure be allowed? This topic was discussed earlier in this chapter as a basic concern of all regulated utilities.⁵

⁴This issue has been discussed previously. See, in particular, pages 136 and 137.

⁵See pages 149 and 150.

The last type of uncertainty to be discussed here, but the one which appears to have provided the initial impetus for using a systematic model, relates to the very fluid nature of the entire environmental quality situation. Midwest Utility finds itself in a position where it must react quickly but carefully to circumstances which are continually changing.

The source of the decision-model.--The specific methodology used by Midwest Utility is derived from a general approach presented to the firm's managers at executive development seminars. This company has a formal, two-level program for management training. All new management personnel are required to participate in a basic supervision course, which deals primarily with human relations and the meaning of employee supervision within a management context. Some time in this course is also spent on the general topic of problem-solving. The second level of professional development comprises the mid-management training course, devoted largely to providing a systematic approach to decisionmaking and problem-solving. Much of this instruction is under the aegis of Kempner-Tregoe Associates, a management-training firm. Indeed, the essentials of the decisionmaking methodology employed by Midwest Utility are presented in a book written by Messrs. Kempner and Tregoe.⁶

Another point is relevant here. Within recent years,

⁶ Charles H. Kepner and Benjamin E. Tregoe, The Rational Manager (New York: McGraw-Hill, 1965).

Midwest Utility has been trying to include lower-level managers in the decisionmaking process. This is the reason why some material on decisionmaking is included in the basic supervision course mentioned above. The theory behind this approach is that if operating managers who will eventually implement the decision have some role in selecting the alternative to be followed, they will better understand the various factors underlying the selection. As a result, these manager-implementers will tend to support the decision to a greater degree than if they had been excluded from the decisionmaking process. The hope is that all this will lead to smoother implementation of the company's plans.

An example of decisionmaking.--Midwest Utility's method for making environmental decisions will be described by examining one particular situation in detail. Recently, the firm was faced with the need to reassess its approach to achieving compliance with air-quality regulations at one of its largest electricity-generating plants. The original plan, approved by the State air pollution regulatory agency, had called for converting most of the units at the plant to low-sulfur residual oil. However, changing conditions within the petroleum industry meant that supplies of residual oil, sufficient to meet the needs of major generating units, could not be considered to be assured over the long term. In addition, managers at Midwest Utility had inferred from the Federal policies concerning oil imports that dependency on foreign supplies of this fuel was not in accord with national interests. These new circumstances had

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100.



convinced Midwest Utility that large segments of its generating facilities could not rely on oil for fuel: other ways of meeting air quality standards must once again be examined.

A second problem had become apparent at about the same time. Because of difficulties in the scheduling of construction of new power plants and in the face of increased customer demand for electricity, the company's management had decided to add additional, coal-fired generating units to its system. Furthermore, the site that had been selected for these new facilities was the same one for which new environmental control methods were required. It should be noted that the decision to build the new units was a fait accompli from the viewpoint of the environmental manager.

After a revised approach to obtaining air-quality compliance at the plant in question had been formulated, the environmental manager of Midwest Utility wrote a formal position paper describing the decision. His stated purposes in preparing this document were:

- "1. To provide a means of recording and communicating the considerations and their evaluations that went into the decisions. . .
- "2. To provide a basis for documentation of the inevitable changes that will occur as new information is obtained or obstacles are approached and overcome."⁷

Description of the model.--The following analysis of the use of Midwest Utility's systematic model for reaching decisions

⁷Quoted from the introduction to the company's internal position paper.

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concerning air quality control within the context outlined above is drawn from three sources: (1) the formal position paper written by the firm's environmental manager, (2) interviews with that manager and his supervisor, the manager for planning and research, and (3) the previously-mentioned book by Kepner and Tregoe, outlining the essentials of their methods.

Step one in the application of the model required that the general objectives and their related measures of attainment be formulated. In this instance, the primary goal was to meet existing environmental regulations while allowing for the expansion of generating plant capacity and to gain acceptance by government officials and the general public. A set of specific compliance measures (in essence, legal requirements) was delineated:

1. A maximum sulfur content for a fuel with a certain heating capacity
2. A maximum concentration, by weight, of particulate matter in the stack gases as well as no visible particulate plume from normal operations⁸
3. A maximum concentration, in parts per million, of nitrogen oxides in the stack gases

After the performance measures were set forth, a number of constraints that must be met by any plan to be implemented were specified.⁹

⁸The requirement of no particulate plume is actually less restrictive than that relating to the specific concentration of particulates.

⁹Kepner and Tregoe call these constraints "musts" or requirements "that cannot be compromised." Ibid., p. 48.

1. The program must be acceptable to regulatory agencies, local officials, and local residents.
2. Reliability and operability must not be compromised in comparison with existing power plant equipment.
3. The plan's cost must remain within the overall cost forecast for the firm.
4. There must be an assured supply of the specific fuel included as part of the plan or, alternatively, there must exist a substitute fuel having an assured future supply and lending itself to ready use with the planned equipment.

The third step in the use of the model comprised the identification, ranking, and weighting (in terms of importance) of the relevant costs and benefits.¹⁰

1. More than minimally-acceptable assurance of public acceptance
2. Assurance of technological success
3. Flexibility: the capability to utilize, at some future time, new or developing technology
4. More than minimally-acceptable assurance of the fuel supply: utilization of "guaranteed" fuel resources
5. Operating costs
6. Capital costs
7. Reduction in generating capacity
8. Preservation of scarce energy reserves
9. Sundry problems

¹⁰Kepner and Tregoe call these factors "wants." Ibid.

This weighting of costs and benefits was the result of "give and take" at meeting attended by the environmental manager, the project manager for air and water quality control, and an operating manager from the power plant in question. These individuals represented varying viewpoints: the operating manager presumably was biased in favor of getting a maximum amount of generating capability, the project manager apparently stressed the technical efficiency of abatement devices, and the environmental manager readily conceded that the ordering of these items was "judgmental" and was based upon the "experience" of each individual as well as his "knowledge of the situation." The "wants" were assigned numbers from one through ten, with the most important consideration being given the largest weight. Not all of the integers between one and ten were used and some "wants" may have been assigned equal weights, indicating a tie in their degrees of importance. It is interesting to note that the low weight placed on sundry problems reflected the situation that for each alternative investigated, all of the "other problems" could be circumvented.

The final phase in the employment of the model consisted of a two-step comparison of the alternative plans.¹¹ Step one was a determination of whether each proposal came sufficiently close to meeting the previously-enumerated constraints. Those alternatives that failed this test were rejected. In step two,

¹¹Analysis of "musts" and "wants" is described in Ibid., Chapter 10 (pp. 173-205).



the remaining proposals were rated, again on a one-to-ten scale, with respect to their relative, anticipated performance on each of the "wants." These ratings picked up various underlying factors: objective, subjective, and probabilistic. As an example of the development of such ratings, the fashion in which the cost factor, "reduction in generating capacity," was handled will be described in the following paragraph. The specific numbers used, but not the essential approach, are merely illustrative.

Four proposals met the constraints. Of these, one had an expected loss in generating capacity, attributable to pollution abatement, of ten percent. The expected generating loss was based upon (1) the technical characteristics of the control equipment to be used--a largely objective and somewhat deterministic consideration--and (2) the anticipated way in which that equipment would be used at this specific plant along with the plant's expected level of operations--considerations that are somewhat subjective and stochastic. This plan was assigned a rating of one for this particular cost. Another alternative entailed an anticipated generating loss of but two percent and was assigned a rating of ten. The two remaining proposals had anticipated generating losses of eight and four percent and were assigned ratings of three and seven respectively. An overall score for each alternative was then obtained by multiplying its rating on each "want" by the weight of that "want" and then finding the sum of these individual products.

In reviewing the scores of the various alternatives in

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order to make a selection, overall differences not exceeding fifteen percent are considered to be insignificant. The environmental manager explained that this is a rule-of-thumb advocated by Kepner and Tregoe and based upon their experience with the actual implementation of their methods by managers in many firms. While this fifteen-percent cut-off is not mentioned in those authors' book, it may be an idea that they consider somewhat proprietary and thus have held it back for use solely in their executive-training programs. At any rate, the percentage difference in the scores of alternative proposals does roughly relate to a level of confidence involved in stating that one project is truly better than another.

The final step of the decision analysis consists of a check for the possible "adverse consequences" that might result from the implementation of the selected alternative. In the specific situation described here, such considerations were formally included as the ninth cost/benefit item, "a minimum of sundry problems."

A critique of the model.--Perhaps the most striking aspect of Midwest Utility's approach to making environmental decisions is the formalization, verbalization, and recording of the investigation of alternatives. With the caveat that a decisionmaker must never become so carried away by a quantitative methodology that he blindly accepts a numerical result without checking to see whether it is reasonable and consistent with his overall understanding of the situation, the use of such an

approach represents a vast improvement over sheer managerial guesswork. Even in its simplest form, the approach followed by Midwest Utility forces managers to seek the factors influencing their decisions and record them on paper--a process that, in itself, can help the managers to clarify their thinking. Indeed, to the extent that the basic ideas presented by Kepner and Tregoe (and used by Midwest Utility) represent essentially a formal and logical approach to decisionmaking, they cannot really be criticized. However, the ways in which these central concepts are applied deserve a deeper examination. In particular, it seems appropriate to discuss first the procedure recommended by Kepner and Tregoe and then to investigate the probity with which Midwest Utility has utilized the approach.

With respect to the steps proposed by Kepner and Tregoe, some ambiguity surrounds the choice of numbers to be used as weights for the "wants" and as ratings, on each "want," for the alternative proposals. While the following discussion will refer explicitly to numbers used as ratings for alternatives, the same arguments apply to weights for the "wants." Two ways of obtaining ratings are suggested by the authors. First, for a given "want," the worst-performing alternative may be assigned a rating of one. Each of the remaining alternatives would then be assigned a rating indicating how many times better its anticipated performance would be than that of the worst alternative. The second approach requires merely that the alternatives be ranked in order of their performance and then be assigned numbers from an arbitrary scale, say one-to-ten. Obviously,

the second method does not consider the degree to which each alternative performs better or worse than each other one. Accordingly, this approach may be considered, from a theoretical standpoint, less desirable than the former. However, even the first method may pose certain conceptual problems, which center about the interrelationships between the weights assigned to the different "wants" and the ratings, of the alternatives, on those "wants." For example, a firm may be very concerned with the costs of operating abatement devices. However, if all of the alternatives under consideration happen to entail very small operating costs, this "want" becomes largely irrelevant to the decision at hand. Because of such interrelationships, all weights and ratings must be reviewed together in order to make sure that the numbers assigned really do make sense. In essence, a common denominator of some sort must be used in making the calculations.

Even if the logical problems addressed above are resolved properly, certain difficulties may be encountered during the actual implementation of the Kepner-Tregoe methodology. The chief question is whether all relevant factors have been articulated and considered. By disseminating information for any "adverse consequences," an affirmative response becomes plausible. But further questions remain concerning how correctly the various factors have actually been evaluated. Has the relative importance or weight of "want" been assessed reasonably? Has the performance or rating of each alternative on each "want" item been evaluated properly? This latter question may be broken down into questions concerning facts and probabilities.



For instance, the decisionmakers at Midwest Utility needed accurate engineering specifications for the different types of abatement equipment as well as reasonable estimates of the probable operating costs and generation reduction that would result from each alternative they had under consideration. In this connection, it is interesting to note that Kepner and Tregoe (and the environmental manager at Midwest Utility) do not specifically separate the facts and probability-judgments underlying each rating.

An alternative formulation: benefit-cost modeling.--Upon reflection, it becomes apparent that the decision model used by Midwest Utility is closely related to the methodologies inherent in programming models and benefit-cost analysis. Indeed, it should be clear that the alternative-selection phase of the model described above could easily be cast in a benefit-cost mold, similar to that developed earlier in Chapter IV. Instead of assigning weights to "wants" and then rating the performance on each "want" of each alternative, the benefits and costs of each alternative could be analyzed within a conventional benefit-cost framework. Whereas the assignment of numbers under the former method is fraught with the conceptual and procedural difficulties described above, the evaluation of costs and benefits seems, at least superficially, to be a more straightforward approach. Furthermore, benefit-cost analysis can readily accomodate benefits and costs that would appear in different time periods, a capability that is not part of the basic method



described by Kepner and Tregoe, although it may be included in some of their actual training courses.

On the other hand, perhaps the thorniest problem in benefit-cost analysis is the measurement and evaluation of individual costs and benefits. Kepner and Tregoe, with their weights and ratings, provide an alternative formulation which seemingly circumvents or at least lessens this difficulty. Yet a nagging suspicion remains that, if benefits and costs cannot be evaluated directly with much precision, the scores of alternatives generated under a Kepner-Tregoe method may be highly inaccurate and misleading. Under either approach, it is safe to say, a sensitivity analysis should be performed to see by how much the weights and ratings (under Kepner-Tregoe) or the estimated amounts of benefits and costs could be varied without changing the indicated decision.

While the two paragraphs above tend to demonstrate a theoretical superiority of the benefit-cost formulation over the Kepner-Tregoe approach used by Midwest Utility, the real test of such methods lies in the results that they produce. The widespread success of the Kepner-Tregoe training sessions would tend to indicate that their method can be readily understood and applied by managers. Certainly their techniques, with many special worksheets and charts to guide managers in implementing the ideas, are highly refined. Used with care and with an understanding of its limitations, this methodology can be a very effective aid to managerial decisionmaking.



A note on controlling sulfur oxides.--In Chapter V, the effort to abate the emission of sulfur oxides was traced from the initial action taken by Congress, through the promulgations of ambient standards by the Environmental Protection Agency, to the setting of specific fuel-input and sulfur-output limits by a regional control agency. The above section of this chapter illustrated the decision-model which Midwest Utility has used to achieve compliance with specific regulations for sulfur oxides (as well as other pollutants). The general circumstances under which the firm must control sulfur oxides will now be briefly explained. Midwest Utility operates fossil-fueled plants within urban-industrial locales as well as in rural areas. The firm has developed three basic strategies for the control of sulfur oxides: (1) converting plants from coal to low-sulfur, residual oil; (2) using low-sulfur, western coal in place of high-sulfur, eastern coal; and (3) building tall stacks to improve dispersion. In addition, the firm is constructing an experimental limestone scrubbing system designed to remove sulfur oxides from the stack gases.

Controlling the Implementation of the Decision

Once an environmental decision has been made at Midwest Utility, the firm's environmental manager takes steps to make certain that he will periodically receive information concerning



whether the plan is being carried out and whether changes are necessary. For certain environmental projects, the framework for such feedback control is furnished by specific agreements entered into with pollution regulators. Often, the overall schedule called for in such agreements contains benchmarks of progress, which may even require the completion of specific reports at interim dates. For a project that does not involve such an agreement, the environmental manager sets up a schedule and asks the manager implementing the project to report back at specified intervals. These communications are handled largely by memoranda. At the present time, this feedback procedure is not automated. However, due to the complexity of many environmental projects and regulations, the firm's environmental manager feels computerization is a pressing need. Indeed, he would like to have some sort of control system that would prepare reports displaying deviation from scheduled costs or times. While no specific steps have yet been initiated to develop such an automated system, there does appear to be some potential to merge such reports with the already-computerized work-order system. This idea will be discussed more fully in Chapter IX.¹²

Environmental Information: Needs and Sources

With the firm's approach to environmental decisionmaking having been outlined, this discussion will now turn to the kinds of environmental information needed by Midwest Utility

¹²See page 222.



and the ways in which they may be obtained.

Specific Reporting Requirements

Midwest Utility must furnish information relating to pollution and its abatement to various governmental agencies. Since it is the form of environmental disruption of most concern to this firm, this section will examine requirements pertaining to air pollution as well as those relating to environmental quality in general. Reporting requirements with respect to other specific forms of disruption will not be discussed.

Two reports filed annually with the Federal Power Commission should be mentioned here. One of these, the Annual Report, includes the basic financial statements together with numerous, detailed, supporting schedules.¹³ The bulk of the material must, under the FPC's regulations, be attested to by Midwest Utility's certified public accountant. The format of the auditor's report required for this purpose is essentially similar to the standard short-form report except that the auditor must give his opinion as to whether the statements and schedules "conform in all material respects with the accounting requirements

¹³Annual Report, Electric Utilities and Licensees (Classes A & B), Washington, D.C.: Federal Power Commission, revised December 1973, (FPC form 1).



of the Federal Power Commission. . ."¹⁴ While the schedules in the Annual Report contain only incidental references to environmental quality, the second report deals explicitly with such data.¹⁵ Detailed information is required concerning fuel consumption at each of Midwest Utility's plants: fuel type; amounts consumed; heat content; percentage of sulfur, ash, moisture, and quantities procured from each supplier. For each boiler at each plant, fuel usage, abatement device performance, and other operating characteristics must be reported in considerable detail. Although some financial data is required in this report, most of the items represent either verbal descriptions or physical units. The CPA does not attest to this report. Similar information, although not quite so wide-ranging nor so detailed, must be reported annually to Midwest Utility's State air pollution regulatory agency and its State public service commission.

In addition to the reports described above, Midwest Utility must supply certain information to the Securities and Exchange Commission, under the provisions of Securities Act Release Number 33-5386. Any potentially-material impact that compliance with environmental standards may have on the firm's capital outlays, income, or competitive standing must be reported. Furthermore,

¹⁴Ibid., pp. 1-11.

¹⁵Steam-Electric Plant Air and Water Quality Control Data. Washington, D.C.: Federal Power Commission, revised July 1973, (EPC form 67).



disclosure is also required of any material costs that may be attributed exclusively to compliance. In connection with such transactions as the construction of a new plant, management should provide an estimate of the portion of construction costs that are environmental in nature, if a reasonable basis for estimation exists.

Considering the reports required by all three of the governmental agencies mentioned above, one can see that Midwest Utility must, by law, furnish environmental information that ranges from the very particular to the quite general and from the strictly financial to the physical and the descriptive.

Information for Decisionmaking

The specific examples, presented earlier, that detailed an application of Midwest Utility's decision-model provide some crucial insights into the needs of managers for environmental information. Perhaps the clearest way to examine such informational requirements would be to restate several of the considerations from the earlier example and, for each of these, describe the kinds of information needed for its analysis. To begin with, the constraint of having a program that is acceptable to regulatory agencies, local officials, and local residents (constraint 1.) translates into a need to meet specific emissions standards. Here the decisionmaker needs to know the currently-effective standards as well as the standards that are likely to apply over the long run. The second constraint, no compromise in

reliability and operability, implies a need for detailed data pertaining to the operation of existing plants. The constraint of not exceeding the firm's financial forecast obviously makes mandatory the availability of budgetary data. Finally, the constraint dealing with the assurance of a fuel supply, contains an implicit requirement for detailed reports on different fuel types as well as individual suppliers.

The nine "wants" imply needs for all of the kinds of information just mentioned as well as detailed technical specifications and financial estimates pertaining to the proposed control equipment. Furthermore, to the extent that the costs and characteristics of abatement devices already in operation can serve as guides to possible future results, reports on their actual past and current performance would be highly desirable.

In addition to the relatively specific kinds of environmental decisions typified by the above-mentioned example, information is required for more general policy-setting considerations by upper-level managers. Such persons must investigate current and prospective environmental standards in order to determine the potential impacts of such regulations on the overall activities of the firm. Underlying problems must be identified and reckoned with. In particular, the ways in which pollution control will affect the firm's profitability must be clearly understood. Such special provisions as the use of county-issued development bonds to lower the effective interest rate to the firm, exemption from certain property taxes, and accelerated depreciation may significantly influence the selection of general abatement

strategies as well as specific compliance measures. Such considerations require information about the firm's anticipated earnings and financial position as well as an understanding of tax provisions and acceptable accounting practices.

The Firm's Accounting System

The previous sections examined Midwest Utility's needs for information for environmental decisionmaking and reporting. At this point, attention will be directed toward one of the major sources--if not the primary source--of such data, the firm's accounting system.

Organization of the accounting function.--The financial division of Midwest Utility is headed by an executive vice-president who reports directly to the firm's president (and chief executive officer). Within the financial division, there are four sections. Two of these have duties generally consistent with treasurership: finance and treasurer. The treasurer's section, in turn, is broken down into the departments of cash management, insurance, and payroll.

The two other sections in the financial division have primarily accounting duties. The controller's section includes the departments of budgetary control, revenue requirements, and financial analysis. Lastly, the accounting section, of most importance to this discussion, comprises the departments of accounts payable, customer accounts, tax, general accounting, and plant accounting.



Extent of computerization.--Midwest Utility's accounting system makes substantial use of computers. The impressive physical size of the firm's computer system is perhaps best conveyed by a listing of its hardware configuration: two IBM/370 model 158 central processors with a total memory capacity of 5,000K bytes, 62 magnetic disks, 21 magnetic tape drives, 9 high-speed printers, 5 card readers, and 5 card punches. Routine data processing is completely computerized and includes such procedures as customer billing, payroll, inventory, accounts payable, general ledger, among others. Many additional functions, which can be considered to be more analytical or decision-oriented than routine data processing, are also implemented on the computer system. Such functions include personnel records, materials and supplies ordering, emergency repair crew dispatching, work analyses, budgeting analyses, load flow analyses, and several others. Financial statements are automatically prepared by the system and include comparative information useful for financial analysis. For instance, the income statement shows the latest month in comparison with the previous month and the corresponding month of the previous year. However, detailed explanations of the causes underlying changes between periods cannot be obtained directly from the computerized system.

As with all utilities, accounting for plant assets is a major function at Midwest Utility. Indeed, historical, detailed plant records were one of the earliest accounting



applications to be automated, via electro-mechanical, punched-card equipment. Since that same sort of hardware continues to be used at the present, plant records that are processed thereon are, strictly speaking, not computerized. Moreover, one key portion of the plant records are not even automated; the generation plant, which comprises land, buildings, and equipment used at the primary sources of power production. Since it is this very facet of the firm's operations which is of greatest relevance to environmental disruption and abatement, the use of a manual instead of a computerized records system probably has a significant impact on the availability of information needed for environmental decisionmaking. While the accounting managers feel that computerization is virtually a necessity in order to be able to isolate many environmental costs included in the plant asset accounts, this conversion is not receiving much priority within the firm. One key impediment is the inability to cost-justify the conversion project in a concrete manner. Since the accounting staff has not yet been able to define unambiguously what constitutes an environmental cost and since environmental reporting requirements have not yet been fully specified by government regulatory agencies and the public accounting profession, the comparative costs of generating environmental information by manual and by computerized means cannot be set forth. In particular, the accounting staff is unable to demonstrate that computerization would clearly lead to cost reductions. On the other hand, a computerized system is likely to improve the general quality of information available for environmental



decisionmaking. The capabilities to generate more-timely information and to furnish alternative arrangements of underlying data in order to disclose meaningful relationships among them appear to be important advantages of a computerized system, albeit ones that do not readily lend themselves to objective measurement. It should be noted that this problem of specifying and quantifying large-intangible benefits has been observed in the development of computerized information systems in many firms.¹⁶

Uniform system of accounts.--Under the rules of its state's public service commission, Midwest Utility uses a uniform chart of accounts developed by the National Association of Regulatory Utility Commissioners (NARUC).¹⁷ This standardized system is nearly identical to the one adopted by the Federal Power Commission (FPC).¹⁸ Moreover, for certain specific instances where the treatment under the FPC system diverges from that under the NARUC system, the State public service commission has specifically adopted the FPC method. As a result Midwest Utility's chart of accounts follows quite closely the

¹⁶ John Dearden, "Systems Organization and Responsibility," in Managing Computer-Based Information Systems, ed. by John Dearden, F. Warren McFarlan, and William M. Zani (Homewood, Illinois: Richard D. Irwin, 1971), pp. 603-4.

¹⁷ A description of this uniform system is available from the National Association of Regulatory Utility Commissioners, P.O. Box 684, Washington, D.C. 20044.

¹⁸ Federal Power Commission, Uniform System of Accounts Prescribed for Public Utilities and Licensees (Washington, D.C.: U.S. Government Printing Office, 1970).



one approved by the FPC. In what follows, this standardized system will be referred to as the "FPC accounts" or the "FPC classifications."

The FPC classifications comprise the basic foundation of Midwest Utility's accounting and, as such, are reflected in the firm's published financial statements. Of course, such statements are summarized and adjusted for any specific reporting standards imposed by the SEC or required in order to conform with generally-accepted accounting principles. Internally, the FPC accounts pose a basic problem in that Midwest Utility's organization structure does not parallel the functional classifications of that standardized system. The company's approach to this inconsistency has been to subdivide the FPC accounts by sub-function and by responsibility. For instance, in the fictional account number "673 QR 814," "673" might be the FPC code for "office equipment," "QR" might be the sub-category for "typewriters," and "814" might pertain to the "Financial Analysis Department." Further breakdowns are often made for the purpose of accounting for responsibility. Indeed, this scheme of identification can be carried down to the level of an individual employee within an administrative unit.

Data recording and accumulation: the "work order."--With the exception of normal operating and maintenance, which are budgeted according to and charged directly to permanent expense accounts, all costs incurred by the organizational units within Midwest Utility are recorded and controlled by an elaborate



"work order" system. The company defines work order as

An authorization, approved by the controller at the request of a department head, to incur expenditures or to purchase equipment or property for a specific project. Approval of a Work Order automatically results in the designation of an account for accumulation of expenditures connected with the project.¹⁹

Since the work order system covers such a wide range of expenditures of Midwest Utility, a detailed inspection of the documents and procedures that comprise the system can furnish useful insights into the firm's overall accounting system. Moreover, such a discussion should help delineate the potential sources of environmental information.

Before examining the work order system proper, some mention must be made of two associated operating budgets. The construction budget includes all approved projects calling for additions to or removals of the company's plant and equipment. By itself, budgetary approval constitutes authority to begin preliminary design and scheduling for the project. An approved work order, however, is required in order to obtain any equipment or materials. The operating and maintenance budget comprises an estimate of the company's annual costs of that nature. Normal operating and maintenance expenditures, as mentioned above, require no work orders; budgetary approval is sufficient for these items. But in the case of extraordinary operating and maintenance costs of a material amount, an approved work order

¹⁹Quoted from the company's instructions concerning work orders.



is needed to authorize the project. In order to have its work order approved, a project must be covered by a specific item in either the construction budget or the operating and maintenance budget.

The process of establishing a work order begins with the submission of a formal request, including an estimate of costs, to the plant accounting department. That department must ascertain whether it or the general accounting department should issue the work order. As a rule, plant accounting processes projects related either to items in the construction budget or to work done for outsiders, while general accounting handles projects related to items in the operating and maintenance budget. Assuming the project falls within its jurisdiction, the plant accounting department makes an entry in its work order register and assigns a number to the project that links the work order to the general ledger account to which the projects' costs will eventually be assigned. If a further breakdown is deemed desirable, the work order may be sub-divided into jobs, each with a unique identifying number.

After this preliminary processing, the plant accounting department forwards the work order to the budgetary control department where a check is made to see if the project is indeed covered by an item in the budget. If there is no budgetary authority for the project, the requesting department is required to submit a budget revision that must be approved by the controller before the work order can be processed further. Once budgetary approval for the project has been substantiated, the work order

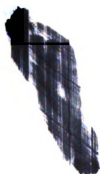


is entered in the budgetary records, information pertaining to the specific covering budget item is recorded on the work order itself, and the work order is returned to the plant accounting department. From there, copies are sent to the requesting department (as verification of approval) and to the stores department (for inventory control). If the controller rejects a work order, it is returned, along with the reasons underlying its rejection, to plant accounting; from there the information is forwarded to the requesting department.

When a work order pertains to a project that the plant accounting department determines should be handled by general accounting, essentially the same procedure as described in the preceding paragraph would ensue. However, the general accounting department would perform all of the functions associated with plant accounting in the above explanation.

After approval of a work order, two additional accounting tasks are performed. One of these is a review, by the tax department, of the Federal income tax treatment of the planned expenditures. Also, the budgetary control department must estimate the amount of cash required to complete the project. Accordingly, that department must secure, from the unit that will do the actual work, a detailed schedule of monthly cash requirements.

Cost control through work orders.--Once the approval procedure outlined above has been successfully completed, all direct costs incurred for the project are charged to the corresponding work order and, if used, job numbers. These costs



are summarized and reported monthly, again according to work order and job numbers. Indirect costs are also charged eventually to the work order, although in quite a different manner. One group of overhead items, consisting mainly of supervision, office, and other general costs, are not charged to a construction work order until the project is completed and the work order is about to be closed. Also, such costs are not included in the initial estimate prepared by the requesting department as part of the application for a work order. Accordingly, these costs are excluded from consideration when actual expenditures are compared with the estimates. For non-construction work orders, on the other hand, these types of overhead costs are included in the original estimates.

A second group of overhead items, pertaining to the operating costs of service departments, are accumulated and applied using an "apportionment account" technique. Under this approach, costs for such a department are accumulated in a special account. Periodically, this apportionment account is closed out to other accounts and work orders, essentially according to the extent to which each other department or project utilized the particular service department. This procedure means that the manager of a department utilizing a service department cannot exercise much control over the cost incurred: the amount apportioned to his own department depends on the efficiency of the service department and the extent to which all other departments call upon the service department.

Upon completion of a construction project, the amounts



are transferred from the work order to the finished plant records.

Matching Information Needs and Sources

The large variety of environmental information that Midwest Utility needs for decisionmaking and reporting implies that many different information sources, both internal and external to the firm, must be tapped. With respect to external sources, the firm's managers can obtain certain information from outside consultants with whom the company has continuing relationships. The public accounting and law firms retained by Midwest Utility are two examples. Publications should also be consulted on a regular basis; these range from the general and financial press, through newsletters and studies published by various industry groups, to specific reporting services published in the areas of taxation, environmental statutes, and SEC regulations. Of course, releases from government agencies and the Financial Accounting Standards Board (as well as other professional accounting bodies) should be obtained and reviewed in a timely fashion. Often these groups will release preliminary, discussion, or exposure drafts of proposed positions that may provide significant lead times over the adoptions of actual requirements. An effort should also be made, most appropriately by engineering groups within Midwest Utility, to keep abreast of technical developments in pollution control.

While the external information sources outlined above



vary considerably from one another, the internal information sources may be roughly classified as dealing with either operating and budgetary data or engineering specifications. Addressing the latter category, such information is usually specific to the particular abatement methodology at hand and is not likely to have too many interrelationships with data used for other purposes at Midwest Utility. Considering this situation from a systems design standpoint, it seems appropriate to have the information system accompanying such data designed quite independently of other information systems for the company. As Dearden proposes, when an information system makes but incidental use of the company-wide data base, not only the specification of users' needs but also the design for the implementation should be controlled by the heads of the departments that will use the information produced.²⁰ In other words, the processing, communicating, and storage of data pertaining to engineering specifications should be considered separate and distinct from the handling of operating and budgetary data relating to environmental decisionmaking and reporting.

The majority of the environmental information required by Midwest Utility does indeed appear to fall into the category of operating and budgetary. In Chapter IX, a case will be made for integrating such environmental information with the firm's accounting system.

²⁰ Dearden, op. cit., p. 597.



The ambiguity of environmental cost classifications.--

key point stressed repeatedly by a top accounting manager at Midwest Utility, is the problem of specifying just what constitutes an environmental expenditure. This difficulty has two component parts. First, the general nature of environmental activities must be described. With respect to air and water pollution control, a committee from the electric power industry proposed, as a guideline, that control costs be considered those that relate "directly to prevention, elimination or control of pollution of the atmosphere and . . . bodies of water and would not be incurred in basic plant operation."²¹ Similar conceptions of environmental costs were voiced by accounting and environmental managers at Midwest Utility. The only real trouble with such a definition is that, in certain instances, it may be no simple matter to determine whether a particular device or technique would be required for the basic operation of the plant.

The second facet of the overall problem pertains to measurement, not definition. Perhaps the most commonly-cited example is the building of a tall smokestack to aid in the dispersion of effluents. Certainly, a smokestack of some size would be required for basic plant operation, but it may be hard to specify just what that "basic" height would be. Furthermore,

²¹ Committee-Accounting for Pollution Control Facilities, "Accounting for and Reporting of Investment Costs and Operating Expenses Relating to Air/Water Pollution Control Facilities," a paper presented at the American Gas Association-Edison Electric



a taller stack requires stronger foundations and such modifications may be included in the basic design of the entire building. The goal here is to calculate the incremental costs of pollution control, that is, the difference between the costs incurred in building and operating a plant with a tall stack and the costs that would have been incurred had no tall stack been included. Yet, the need to build a tall stack may have influenced decisions concerning the new plant in so many ways that no straightforward comparison is possible. Without the requirement of a tall stack, the plant might have been built at a different location, with a greater or lesser generating capacity, or with some other essential difference.²²

The complications mentioned above, while important, should not be overemphasized. It is quite plausible that in many, if not most, instances some reasonable basis exists for calculating the incremental cost of pollution control. The key point here is that the determination of such a basis requires careful study of the specific situation at hand. Furthermore, in the case of external reporting, some generally-accepted guidelines would seem to be called for. This topic will be

Institute Accounting Conference, San Francisco, May 1973, p. 5. (Duplicated)

²² It should be pointed out that since the tall stack merely aids the dispersion of effluents rather than reducing their amount, some pollution regulatory agencies would not consider the extra costs incurred with such a structure to be abatement expenditures. Also, the Internal Revenue Service would not consider this a pollution control facility for the purpose of rapid amortization under the Internal Revenue Code ("Accounting for and Reporting of Investment Costs," p. 3).



addressed in Chapter X.²³

At this point in the dissertation, the nature of environmental decisions made by government agencies and by business firms, and the pertinent informational requirements for making such decisions, has been investigated. Conceptual notions and empirical evidence have both been presented. In the next chapter, the third and final category of environmental decisions--those made by individuals who use published financial reports--will be analyzed.

²³See page 260.



VIII. DECISIONMAKING BY USERS OF PUBLISHED FINANCIAL REPORTS

This chapter will conclude the survey of environmental decisionmaking. While decisions made by government agencies and firms were discussed in preceding chapters, this chapter will concern decisions made by individuals (or, in some cases, firms) who use published financial statements, generally those included in an annual or interim report to stockholders. This survey will begin with an identification of the users of financial statements and an overview of their needs for accounting information. The second half of this chapter will consider the audit function as it affects the use made of the published statements. In particular, the underlying needs for an audit as well as the various forms audits may take will be delineated.

The Users and Their Needs for Information

The general topic of users' needs for accounting information has garnered considerable interest in recent years. Without claiming that the numerous issues pertaining to this subject have been resolved, the discussion here will be based upon the conclusions stated in the report of the AICPA's



"Trueblood Commission."¹ There are essentially two reasons for adopting this approach. First, an adequate examination of users' needs could conceivably comprise a research study in itself and, as such, goes beyond the scope of the present project. Second, the "Trueblood Commission" carried out such a study as part of its efforts. Since that study group delved into the general literature on this subject and since the group's members included well-known accountants with diverse backgrounds, it seems quite reasonable to accept that group's conclusions as being eminently authoritative. Indeed, in its discussion memorandum on a Conceptual Framework for Accounting and Reporting, the Financial Accounting Standards Board acknowledges the standing of the "Trueblood Commission's" report and concludes that further research covering the same ground would constitute "an unjustified duplication of effort."²

Which users are of concern?--The "Trueblood Commission" concluded that it is the function of financial statements "to serve primarily those users who have limited authority, ability, or resources to obtain information and who rely

¹Study Group on the Objectives of Financial Statements, Objectives of Financial Statements (New York: American Institute of Certified Public Accountants, 1973), p. 17.

²Financial Accounting Standards Board, Conceptual Framework for Accounting and Reporting: Consideration of the Report of the Study Group on the Objectives of Financial Statements (Stamford, Connecticut: The Board, 1974), p. 2.



on financial statements as their principal source of information about a firm's economic activities."³ While these users may be present or prospective shareholders, creditors, or employees, each must make some sort of "investment" decision about a firm. Hence, they all have similar needs for information. As to the degree of sophistication such users bring to the interpretation of financial statements, the report states that "accounting information should be presented so that it can be understood by reasonably well-informed . . . users."⁴ Finally, it should be re-emphasized that the "Trueblood Commission" considered primarily those users who make economic decisions. With respect to environmental disruption, however, some users may make decisions upon a non-economic basis. This complication will be addressed more fully below.

How do the users make their decisions?--Underlying each decision made by an individual is a goal or set of goals. For some decisionmakers, goals are stated in quite broad terms, if they are formulated at all! On the other hand, many decisionmakers, functioning in a more formalized fashion, have a complex goal structure that may be well-articulated. But whether he makes it implicit or explicit, each decisionmaker has one goal that relates to his relative preference

³Objectives of Financial Statements, p. 17.

⁴Ibid., p. 60. Emphasis added.



for assuming risks.⁵ Other common goals pertain to the individual's preferred pattern of benefits and costs over time.

With these and other goals in mind, the decisionmaker must proceed to evaluate the benefits and costs relevant to the alternatives under consideration. If such factors were amenable to precise and objective identification and measurement, decisionmaking would be a trivial undertaking indeed! Thus a key characteristic of all decisionmaking is the uncertainty about amounts and timing of costs and benefits.⁶

What are the characteristics of the required information?--In A Statement of Basic Accounting Theory (ASOBAT), a committee of the American Accounting Association commented: "The utility of information lies in its ability to reduce uncertainty about the actual state of affairs of concern to the user."⁷ Accordingly, that committee formulated four basic standards which, taken as a whole, must be substantially fulfilled in order for some data to be acceptable as accounting information. The first standard, relevance, "requires that either the information or the act of communicating it exert influence or have the potential for exerting influence" on the decision at hand. Thus, such "information must be available in a form and at a time for it to be useful." The

⁵Ibid., p. 18.

⁶Ibid.

⁷Committee to Prepare a Statement of Basic Accounting Theory, A Statement of Basic Accounting Theory (Evanston, Illinois: American Accounting Association, 1966), p. 8.

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committee concluded, moreover, that relevance has a "position of primacy" among the four standards.⁸ The second standard, verifiability, pertains to the ability of competent persons to reach "essentially similar measures or conclusions from [independent examinations] of the same evidence, data, or records."⁹ While verifiability is an important characteristic of all accounting information, it is particularly crucial with respect to the use of accounting reports by third parties and, to a significant extent, underlies the ability of an independent auditor to render an opinion on those reports.¹⁰

The third standard for accounting information, freedom from bias, requires that the interests of no party are favored over those of other parties. Again, this standard is of special importance in external reporting.¹¹ The fourth standard, quantifiability, "can be considered as the association of a number with a transaction or an activity where the numbers assigned obey prescribed arithmetic laws or procedures."¹² Valuation in monetary terms is thus a "special case of quantification."¹³

In addition to the characteristics of accounting

⁸Ibid., p. 9.

⁹Ibid., p. 19.

¹⁰Ibid., pp. 10-11.

¹¹Ibid., p. 11.

¹²Ibid., pp. 11-12.

¹³Ibid., p. 12.



information itself, ASOBAT also considers the quality of the reporting or communication process and provides five specific guidelines. The first such guideline, appropriateness to expected use, "requires that reports be prepared with the intended user's needs in mind."¹⁴ In particular, the information needs peculiar to such specific reports as income tax returns and reports to regulatory agencies should not be permitted to influence the general accounting statements.

The second reporting guideline, disclosure of significant relationships, requires that the information be presented in a manner that will allow the user to "understand and evaluate the underlying activity generating the data."¹⁵ This guideline concerns three potential problems. First, the appropriate degree of summarization must be determined: too much summarization has the effect of burying important details, while too little summarization may cause the reader undue difficulty in finding the significant relationships. Second, care must be taken in selecting the scheme or schemes of classification to be used. For instance, if expenses are classified in the income statement solely according to function, natural and behavioral relationships will tend to be obscured. Third, the specific procedure to be employed in aggregating the data must be chosen and reported carefully since "many mathematical operations performed on aggregated

¹⁴ Ibid., p. 14.

¹⁵ Ibid., p. 15.



data yield results different from those obtained when the same operations are performed on the unaggregated data and the results then aggregated in the same manner as before."¹⁶

The third guideline for communicating accounting information, inclusion of environmental information, "requires that the circumstances and methods" underlying the preparation of the report "be disclosed if there can be any reasonable doubt about such matters in the mind of the recipient of the information."¹⁷ The fourth reporting guideline, uniformity of practice, requires that "where various alternative methods of measuring an economic activity exist, . . . the best available one be used uniformly within a firm, by different firms, and, to the extent possible, by different industries."¹⁸ Without uniformity, it seems unlikely that the standard of freedom from bias, described above, can be met. For if there are numerous alternative methods available, the parties that have authority over the preparation and dissemination of financial reports can select that method which best fits their own purposes.¹⁹

The fifth and final reporting standard presented in ASOBAT, consistency of practice through time, pertains to both measurement and reporting and "should relate to basic

¹⁶Ibid.

¹⁷Ibid., p. 16.

¹⁸Ibid., p. 17.

¹⁹Ibid.



concepts reflected in accounting abstractions such as the nature of business income as well as to the terminology and, perhaps to a lesser extent, to the format of reports."²⁰

These four fundamental standards for accounting information and five guidelines for the communication process furnish a comprehensive description of the qualitative characteristics of the information needed by users of financial statements. Since these considerations pertain to information which is generally useful to individual decisionmakers, they can be used as benchmarks against which may be assessed the propriety of reporting and the feasibility of auditing various types of information pertaining specifically to environmental disruption. While such analyses will be presented in the following two chapters, it seems appropriate at this point to consider the nature of decisions statement users make concerning environmental quality.

Environmental decisions of financial statement users.--

Users of published financial reports may make two different types of decisions about a firm's environmental activities. First, such persons may desire to assess the likely impact of disruption and its abatement on the firm's financial position and its earnings potential. In other words, environmental quality may be an additional factor that affects the financial decisions traditionally made by statement users. But in

²⁰ Ibid., p. 18.



addition, such users may desire to gauge the appropriateness and effectiveness of the firm's environmental policies.

Indeed, an investor may choose not to purchase the stock of a particular firm not because of a negative financial impact of abatement requirements but because he does not support the firm's particular abatement policies. The Dreyfus Third Century Fund, a mutual fund, has pledged to invest in the securities of firms that seek to improve environmental quality or other factors enhancing the quality of life.²¹ Moreover, individuals with no economic interest, actual or potential, in a firm may also make decisions concerning the firm's environmental policies. Consumer advocates, political activists, or concerned citizens may take action supporting or opposing a particular firm. In short, statement users may make decisions about either the financial impact or the appropriateness of a firm's environmental activities or both.

The Independent Auditor's Attest Function

In the previous section, the users of published financial statements and the information they require for their decisionmaking were described. In particular, a set of qualitative standards for accounting information and guidelines for the reporting process were presented. Such benchmarks serve little purpose, however, unless the readers

²¹ "Report of the Committee on Environmental Effects of Organization Behavior," The Accounting Review, Supplement to Volume XLVII (1973), p. 89.



of financial statements have some assurance that they have been adhered to. Accordingly, users generally require independent attestation to the financial reports. Three different institutional forms for this audit function seem noteworthy here; they will now be discussed.

The financial audit.--The independent auditor has traditionally been called upon to render his professional and disinterested opinion concerning the credibility of a firm's financial statements. Simply put, the auditor seeks to determine whether the statements conform to generally-accepted accounting principles and thus constitute a "fair presentation." More specifically, the auditor serves as a check against "personal bias, self-interest, carelessness, or even outright dishonesty."²² In the words of the American Accounting Association's Committee on Basic Auditing Concepts: "Attestation is a communicated statement of opinion (judgment), based upon convincing evidence, by an independent, competent, authoritative person, concerning the degree of correspondence in all material respects of accounting information communicated by an entity . . . with established criteria."²³ In developing a conceptualization of the audit

²²Howard F. Stettler, Auditing Principles (Third Edition; Englewood Cliffs, N.J.: Prentis-Hall, 1970), p. 1.

²³"Report of the Committee on Basic Auditing Concepts," The Accounting Review, Supplement to Volume XLVII (1972), p. 22.



function, that committee identified two types of decisions a user must make when he receives a report.

- "1. The user must interpret the information content to gain knowledge of the subject matter relevant to his needs.
- "2. The user must evaluate (implicitly or explicitly) the quality of the information received."²⁴

The committee stated that the attest function essentially serves to aid the user in making the latter decision, since four conditions make it difficult for the user to "satisfy himself directly," while making it crucial that the question be resolved.²⁵ First, the user will become worried "about the possibility of bias in information received" if he "perceives an actual or potential conflict of interest between himself and the preparer/source of the information . . . "²⁶ Second, the greater the consequence of his decision, the more the user desires to ascertain the quality of the information available to him. Third, with the increasing complexity of of the subject matter and the information-processing system related to the reports he receives, the user finds it ever harder--if at all possible--to satisfy himself about information quality. For with increasing complexity, both the chance of occurrence of unintended errors as well as the expertise

²⁴Ibid., p. 25. Emphasis in the original.

²⁵Ibid.

²⁶Ibid., p. 26. Emphasis added.



needed to assess information quality expand rapidly. Finally, direct satisfaction is blocked by the "separation between the user . . . and the subject matter and preparer of the information."²⁷ This separation may result from lack of physical proximity, "legal or institutional barriers to access . . . , [or by] time and cost constraints which make it infeasible for the user to perform his own audit investigation."²⁸

The combined impact of these four conditions is that attestation by an independent third party must be considered to be a necessary component of the system for communicating accounting information to financial statement users.

The operational audit.--While attestation in the context of the financial audit is closely linked to the independent accountant, the operational audit represents essentially an outgrowth of the function long served by the internal auditor. Operational audits "measure . . . the extent of achievement of organization objectives" and produce reports "recommending improvements to increase the efficiency and effectiveness of operations."²⁹ With respect to audits of governmental agencies and programs, the U.S. General Accounting Office has defined three distinct components.³⁰ The

²⁷ Ibid. Emphasis added.

²⁸ Ibid.

²⁹ John J. Willingham and D. R. Carmichael, Auditing Concepts and Methods (New York: McGraw-Hill, 1971) p. 27.

³⁰ Standards for Audits of Governmental Organizations, Programs, Activities & Functions (1974 Reprint; Washington, D.C.: U.S. Government Printing Office, 1974), p. 2.

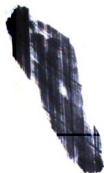


first of these, financial and compliance, concerns the propriety of the organization's financial affairs, the fairness of its financial statements, and the extent of its compliance with relevant laws and regulations. This element seems to be largely similar to the financial audit function with, perhaps, added emphasis on legal compliance. The next aspect, economy and efficiency, deals with the entity's management or utilization of its resources and seeks to uncover inefficiency-causing "inadequacies in management information systems, administrative procedures, or organizational structure."³¹ The third facet of the audit of governmental organizations comprises a determination of whether the results desired are indeed being obtained, whether the specific objectives promulgated by the authorizing agency are being met, and whether the implementing organization has attempted to find lower-cost methods for achieving the desired results. These GAO standards were not intended as mere descriptions of contemporary audit practice. Rather, they purposely contain "some concepts and areas of audit coverage which are still evolving in practice but which are vital to the accountability objectives sought in the audit of governments and of governmental programs."³²

As indicated above, internal auditors and governmental auditors often perform operational audits. Some of these

³¹Ibid.

³²Ibid.



individuals may have backgrounds in areas other than accounting: operational auditing is truly interdisciplinary and often requires legal, engineering, management, and computer science skills as well as accounting expertise. To a limited extent, however, CPA firms do perform some operational auditing as part of the traditional financial audit. Typically, when an independent auditor discovers possible inefficiency or ineffectiveness in operations, he brings it to the attention of management, although he would not mention it in his formal report unless it has a direct and material impact on the financial statements. Moreover, management consultants, whether from the management advisory services group of a CPA firm or from other types of organizations, are often engaged expressly to conduct some sort of operational audit. Yet, the role of such outside consultants differs from that of the independent auditor: the consultant renders his report to management and has no reporting obligation to third parties.

The social audit.--During the past few years, a number of proposals have been made that urge the conduction of social audits of business firms. In one sense, these audits would combine the general approach of operational auditing, although limited to the "social responsibility" aspects of firms' operations, with some obligation for the auditor to report to third parties. David F. Linowes, who has authored several articles on "socio-economic accounting," proposes that firms develop internally a "socio-economic operating



statement."³³ This statement would provide "a tabulation of those expenditures made voluntarily by a business aimed at the 'improvement' of the welfare of the employees and public, safety of the product, and/or conditions of the environment."³⁴

Linowes would exclude all outlays made in order to comply with specific provisions in the law or in union contracts. Negative items would be shown on the statement "when a responsible authority brings the need for social action to the attention of management, but management does not voluntarily take steps to satisfy such a need, even though it is of such a nature that a reasonably prudent and socially aware business management would have responded favorably."³⁵

While admitting that decisions concerning what should appear in the socio-economic operating statement are quite subjective, Linowes claims that such subjectivity underlies much of the traditional financial statements as well. Moreover, the author provides a set of guidelines for the identification and classification of socio-economic actions.³⁶

Linowes would have a small, interdisciplinary team of the firm's employees, headed by an accountant, prepare the statement. An audit would then be performed by an

³³David F. Linowes, "An Approach to Socio-Economic Accounting," The Conference Board Record, November 1972, pp. 58-61.

³⁴Ibid., p. 59. Emphasis added.

³⁵Ibid. Emphasis is in the original.

³⁶Ibid.

outside, independent, interdisciplinary team headed by a CPA.³⁷

A methodology similar to that of Linowes has been proposed by Professors Dilley and Weygandt.³⁸ Furthermore, a "social responsibility operating statement" was prepared for an actual firm as the result of a social audit performed by one of the authors.³⁹ Dilley and Weygandt describe four conceptual bases for the preparation of the social responsibility statement. The inventory approach would provide a listing of the firm's socially-responsible activities. However, the authors contend that it would be difficult to establish rules governing what should be included in such a statement and that such listings could not easily and meaningfully be used as the basis of comparisons among firms.⁴⁰ The program management approach would require disclosure of the amounts spent on each activity along with a statement of whether the program's goals are being met. The benefit-cost approach is similar, but would include a monetary evaluation of the benefits from each expenditure. Yet, the formulation of specific objectives for social responsibility programs and

³⁷ Ibid., p. 61.

³⁸ Steven C. Dilley and Jerry J. Weygandt, "Measuring Social Responsibility: An Empirical Test," The Journal of Accountancy, September 1973, pp. 62-70.

³⁹ Steven C. Dilley, Accounting for Externalities: Conducting a Social Audit and Preparing a Social Responsibility Annual Report for a Public Utility, unpublished doctoral dissertation, University of Wisconsin--Madison, 1972.

⁴⁰ Dilley and Weygandt, op. cit., p. 64.



evaluation of benefits are both difficult to achieve. Accordingly, the authors recommend, as an initial step, the adoption of a cost or outlay approach under which a firm would describe its socially-responsible activities and state the amounts spent on each. The authors are quick to point out, however, that even this methodology presents certain conceptual weaknesses, including the existence of alternative definitions for the cost of an activity and the fact "that high dollar expenditures do not necessarily mean excellent benefits."⁴¹

Dilley specifically addresses the question of who should conduct the social audit, discussing three possibilities. First, the auditors might be a team from the management services staff of a CPA firm.⁴² While many MAS personnel do have backgrounds and skills appropriate for participating in a social audit and while certain CPA firms have engaged in this sort of work on a consulting basis, CPA firms might not wish to expose themselves to legal liabilities that could ensue from social auditing. Then too, a CPA firm might fear compromising the perceived integrity of its financial audit of a client if it were to perform that client's social audit as well.⁴³

⁴¹Ibid., p. 64.

⁴²Dilley, op. cit., p. 87.

⁴³Ibid., p. 88.

Dilley mentions the possible performance of social audits by government agencies, but he concludes that, although such agencies might prepare industry- or region-wide reports, they probably could not or would not audit individual firms.⁴⁴ Lastly, Dilley suggests that independent research organizations may be a viable alternative to MAS personnel from CPA firms, for the conducting of social audits.

In a different report, Bauer and Fenn discuss the performance of social audits on behalf of three distinct groups.⁴⁵ First, a business may conduct a self-audit as a basis for either internal decisionmaking or public reporting of socially-relevant activities. The authors state four possible reasons why social audits might be conducted for internal purposes: (1) "satisfying the corporate conscience," (2) "anticipating and avoiding pressure" from the public or from government agencies, (3) gaining understanding that will help the firm in "solving social problems," and (4) increasing "long-range profits."⁴⁶

Investors represent a second group that might "sanction" social audits. However, "since the social critics are likely to be concerned with a wider and shifting range of issues

⁴⁴Ibid., p. 89.

⁴⁵Raymond A. Bauer and Dan H. Fenn, Jr., The Corporate Social Audit (New York: Russell Sage Foundation, 1972), especially pages 43-79.

⁴⁶Ibid.



than the investment community might consider, investor audits may not serve the entire range of interests of the social critics."⁴⁷ Accordingly, social audits might well be sponsored or conducted by a third group, public interest organizations.

The three types of audits described above; financial, operational, and social; may be of varying degrees of assistance to users of published financial statements. Moreover, the extent to which independent attestation is feasible with regard to environmental reports published by firms may depend critically upon the alternative institutional arrangements available for conducting the audit, and vice versa. These and other related considerations will be examined in Chapter X.

The discussion, in this chapter, of the decisions made by private individuals who use published financial reports concludes the analysis of the nature of and the information required for environmental decisionmaking. In the next chapter, then, the focus will shift to an investigation of the potential scope of the accounting function, as it pertains to environmental decisions.

⁴⁷Ibid., p. 45.



IX. THE ACCOUNTING FUNCTION AND ENVIRONMENTAL INFORMATION

In these, the final two chapters of the dissertation, the many threads that were developed in the earlier chapters will be drawn together to form conclusions about the present and prospective scope of the accounting function as it pertains to environmental decisionmaking. At this point, it is useful to recall the four issues initially raised early in Chapter I:

1. What are the natures of various environmental decisions?
2. What general kinds of information are relevant to these decisions?
3. What portions of this information might reasonably be supplied through the accounting function?
4. By what means and to what extent could accountants gather, report, and audit such information?

Answers to questions one and two have been largely supplied in the preceding chapters. However, questions three and four, dealing specifically with the role of the accounting function as it relates to environmental decisions, remain to be resolved. Therefore, the present chapter will investigate the accounting function within government agencies and firms. The following chapter will deal with the possibility of extending the accountant's attest function to published reports as well as to special reports required by specific government agencies.

Accounting Information for Governmental,
Environmental Decisionmaking

The information needed for economic studies conducted by government agencies was described in Chapter IV.¹ In this section, the problems that economists encounter in the use of accounting data as inputs to their models, as well as potential solutions to those problems, will be investigated. It will be demonstrated, in a later section of this chapter, that many types of environment-related information which are or would be useful to managers and users of published statements would also be useful for economic studies by government agencies (and independent researchers!). By resolving some of the difficulties inherent in the accounting reports used by managers and outsiders, many of the economist's complaints could be answered as well.

After this discussion of matters pertinent to economic analysis, a demarcation will be made of those activities which are consistent with the accounting function within government agencies. That section will draw heavily upon the empirical study, contained in Chapter V, of a regional air pollution control agency.

Accounting information and economic analysis
of environmental quality.--Much of the data--discussed

¹See pages 92-97 above.

in Chapter IV--that is of interest to economists for their environmental studies pertains to financial characteristics or activities measured and recorded by accountants within individual firms. However, the manner in which such information is developed within the accounting function often poses serious conceptual problems for economic analysts. Accordingly, it is not enough merely to state the possible "topics" that might be addressed by the accounting function: the ways by which conceptual deficiencies may be overcome must also be scrutinized.

Depreciation charges enter into the economic analysis of environmental quality in several ways, including such considerations as the cost of using abatement equipment, the obsolescence of manufacturing plants due to increased stringency of environmental regulations, and the possibly hastened lowering of real and personal property values due to pollution damage. Some difficulty stems from the treatment of depreciation in the Internal Revenue Code. While "book" and "tax" treatments need not be identical, depreciation calculations for a company's published financial statements are often affected by such Code provisions as the assumption of unrealistically-short service lives and accelerated depreciation methods. These influences, along with the frequent changes in the Code, greatly confuse the interpretation of reported depreciation charges.²

²William D. Nordhaus, "The Falling Share of Profits," Brookings Papers on Economic Activity, 1:1974, p. 171-73.

Moreover, economists and accountants do not seem to agree on the definition for depreciation. To an economist, depreciation represents the decline in the present value of unexpired asset services; while to an accountant, it is a periodic allocation of the historical cost of an asset to expense over the asset's useful service life. However, even within the accounting profession, there is a considerable interest in moving to a current-cost basis for the valuation of assets and the calculation of depreciation, a change that would greatly improve the usefulness of such data for economic analysis.

The need for current values is also important for comparisons over time of capital and operating costs related to fixed assets and of inventory costs. Along one dimension, price-level adjustments would be of great assistance in filtering out illusory changes due to inflation. Beyond this correction, however, changes in specific prices must also be considered if unwarranted conclusions are to be avoided concerning such things as the differences in a firm's operating and investment costs before and after imposition of strict environmental regulations.

Similarly, economists must consider changes in returns to providers of capital due to disruption abatement. While accountants do report interest and dividend charges separately, much more elaborate disclosure is required concerning the nature of and the returns to individual classes of security-holders: the capital structures and the nature of outstanding securities of large corporations have complexities that render



lesser disclosure inadequate. In essence, much more attention must be paid to the structural components of the cost of capital to a firm.

The nature of individual cost factors.--Conventionally-prepared financial statements tend to obscure certain interrelationships among cost factors. An understanding of these interrelationships is crucial to economic analysis and, thus, information tending to reveal them can well be used by governmental decisionmakers. The behavior of costs as a firm's volume of production or sales varies is not readily disclosed by the conventional, published income statement, although variable-costing statements are often prepared for management's own use. The general availability of this later type of income statement would greatly facilitate economic analysis, particularly if such statements contained sufficient detail and also adequately analyzed semi-variable costs and "discretionary" and "committed" fixed costs.³

In much the same way, segmental reports showing the costs of operation as well as the investment in assets for each of the various divisions of a firm would improve the economic usability of accounting information. The key question

³For definitions of these types of costs see Charles T. Horngren, Cost Accounting: A Managerial Emphasis (Third Edition; Englewood Cliffs, New Jersey: Prentice-Hall, 1972), pp. 943-53.

here is the directness of each cost item. Costs that are not directly-identifiable with a specific department or function within the firm must not arbitrarily be allocated. The current efforts by the Federal Trade Commission to secure line-of-business reports have generated some controversy among accountants as to whether such reports would be meaningful or obtainable with reasonable effort and cost.⁴ Once again, however, detailed segmental reports are often prepared for internal use within large firms.

A final facet of cost interrelationships relates to the purpose for incurring each cost. Consider a situation in which a plant manager is given a chauffeur-driven limousine to get to and from work. In one sense, this cost is directly-identifiable with the specific plant. On the other hand, the plant could still be operated (at least in the short run) even if its manager had to drive his own compact car to the office. In such a situation, the limousine might really represent an addition to the manager's salary. Moreover, the company might need to make such perquisites available in order to secure the services of highly-qualified managers. Still, in trying to specify the production function for the plant it would be handy at least to know the nature of such cost items: some costs are more "essential" to a firm's basic operations than are others.

⁴"Line of Business Reporting," The Journal of Accountancy, June 1974, p. 3.

Finally, some mention should be made of the fact that economic models tend to stress marginal costs and benefits while business firms usually make investment decisions based on incremental costs and revenues. Depending on the size of the firm and the project, and also on the degree of aggregation inherent in the economic model being employed, this distinction may or may not be very important. But regardless of whether any problems arise due to the use of incremental rather than marginal analysis, accounting statements, even if they include all of the modifications discussed in the preceding paragraphs, do not generate performance measures for specific decisions. In particular, even a firm that uses a discounted-cash-flow approach to capital budgeting--the method receiving the greatest authoritative support--to reach a specific investment decision, will still prepare subsequent financial statements under the conventional, accrual basis. Future income statements will simply not reflect the considerations that went into the capital-budgeting decision. In this setting, some supplementary, analytical information concerning opportunity costs is required.

The Accounting Function within Environmental-Control Agencies

The above discussion demonstrated the pertinence of accounting data to decisions being made by government agencies concerning economic aspects of environmental disruption and its control. With the possible exception of the specification of certain reporting rules by persons employed by government

units, the accounting chores related to the gathering and reporting of the required information are performed exclusively by employees of individual firms. In this section, the role of the accounting function within government agencies will be investigated. The empirical study of the Wayne County Air Pollution Control Division will be used to guide this examination.⁵

Administration of regulatory agencies.--The general description of the activities of the Division indicates that accounting for the administrative aspects of such agencies is fully in accord with the "conventional" accounting function. Moreover, it seems likely that this type of accounting work is now beginning to receive a good deal of priority. Many such agencies probably find themselves in the same situation as the Division, with most disruption sources in their jurisdictions either under control or progressing along a control program and with their regulatory machinery in reasonably-full operation. Regulatory agencies seem to have progressed from a period of rapid development into a phase of stable operation, enabling them to give increased attention to the administrative aspects of their responsibilities.

Setting environmental standards.--As mentioned briefly above, accountants at governmental agencies should be involved in the design of reporting forms to be completed and returned

⁵See Chapter V.

by subordinate agencies and individual firms. Obviously, accountants with systems experience have special skills in the general area of forms design. Furthermore, much of the information to be included in these reports is of a financial character.

With respect to the analysis of the benefits and costs relating to alternative proposed regulations, accountants may be able to participate in a useful manner. In particular, the study of the potential impacts of regulations on the financial position and earning power of various types of firms is likely to involve a considerable amount of financial statement analysis, an activity that lies along the "boundary" between accounting and finance. In general, benefit-cost analysis requires an interdisciplinary approach: accountants; along with financial analysts, economists, statisticians, engineers, and others; can make worthwhile contributions.

Information systems design.--If the experience of the Wayne County Air Pollution Division is at all typical, it appears that major responsibilities are evolving for persons associated with the accounting function within disruption-control agencies, pertaining to the design and operation of comprehensive management information systems. Such a system must deal not only with the administrative accounting for the agency but also with information that is relevant to setting and enforcing standards. Pooled data from firms under the agency's authority form, to a considerable extent, the basis for the specification of emissions limits. Moreover, in order to monitor an individual

firm's disruption and control actions, the agency must have an adequate and accessible historical record of the firm's past disruption levels, commitments to abatement, and violations. While much of the information handled in such an information system is not of a financial nature, the functions of continual data-processing and information-storage-and-retrieval are closely analogous to those within traditional accounting systems. Therefore, the persons who are given responsibilities for these comprehensive information systems are likely to have backgrounds in accounting work. A description of a proposed management information system for the Wayne County Division is included as Appendix A at the end of this chapter.

Grant approvals.--Another area where accountants within government agencies may participate meaningfully is the grant approval process. It should be noted that most of this activity is carried out at the Federal level, within the Environmental Protection Agency. Specifically, accountants should take part in the review of grant applications, since budgets and other financial reports are generally submitted in support of a request for funds. In addition, accountants should properly be responsible for the running of performance audits to see whether Federally-funded programs at State and local agencies and demonstration projects run by government agencies or private firms are proceeding or have been completed according to plans.

The Accounting Function within Private Firms

The previous section of this chapter dealt with the tasks which can appropriately be associated with the accounting function within governmental, disruption-control agencies. In this section, similar consideration will be given to the scope of the accounting function within business firms, as it pertains to the firms' environmental affairs. Many of the issues raised here will be linked to the discussion, in the ensuing chapter, of the extension of the audit function to environmental reporting. Throughout this section, references will be made to the empirical study (Chapter VII) of Midwest Utility, in order to establish a factual basis for the plausibility of the conclusions presented.

The impact of environmental quality on

the financial statements.--Perhaps the most basic and conventional role a firm's accountants can play with respect to environmental decisionmaking is to assess the impact of regulations and abatement activities on the firm's financial statements. Due to the wide-ranging nature of environmental laws combined with the considerable extent of disruption and abatement activities of most sizable producing firms, accountants must keep close tabs on a firm's environmental affairs if the statements are to present fairly either the firm's financial position or the results of its operations. Furthermore, in reports

to different regulatory agencies--the Securities and Exchange Commission, the Federal Power Commission, and State pollution regulators were three examples for Midwest Utility--financial data as well as physical measures and descriptive material must be provided. While it is true that in very large firms report-preparation can become a highly specialized activity, in many businesses it is the accounting staff that bears the primary responsibility for filing required reports of all types. Therefore, in submitting special reports to government agencies, accountants must determine the financial ramifications of the firm's environmental actions and perhaps provide non-financial data in addition.

Managerial decisionmaking.--Since environmental affairs are far from the only concern of a firm's management, decision-makers must coordinate environmental policies with overall company goals. While both quantitative and qualitative factors must be considered, financial measures are generally used as the common denominator. Similarly, in the making of specific environmental decisions, accounting data are necessary inputs. The typical abatement action involves an investment situation calling for the use of capital budgeting. For Midwest Utility, as is likely to be true for all firms, the majority of the inputs required for this sort of analysis are derived from historical or forecasted financial data.⁶

⁶See Appendix B at the end of this chapter.

Once an environmental decision has been made, some sort of managerial control must be implemented. In general, feedback is required concerning whether the financial and non-financial aspects of the project are progressing according to plan. The study of Midwest Utility illustrates most strikingly the potential contribution that could be made to such managerial control by the accounting function. There, as in most large firms, an elaborate cost accounting system is in operation. Financial budgets and analyses of variances from budgeted figures are regularly prepared for environmental projects as well as for all other operating segments of the firm. Concurrently, however, the environmental manager of that firm establishes an independent feedback system to aid his own control of environmental programs! Surely there must be many ways in which these two sorts of control systems could readily be integrated. At the very minimum, time and percentage-of-completion measures could be added to the financial budgets and variance reports. Within a sophisticated, computerized information system, the special needs for financial and operating control reports could be met from a common data base with the added advantage of improved coordination between these two functions.

Information systems design.--The considerations mentioned in the paragraphs above lead quite naturally to an examination of the needs for and the development of information systems for environmental decisionmaking and reporting. In essence, a firm needs a ready and reliable

source of data that are germane to the planning, reporting, and controlling of its environmental affairs. At least four reasons may be identified that tend to support the view that the accounting staff should have major responsibilities for the design and operation of these information systems. First, much of the data used in such systems are monetary in nature--the sort of data with which accountants are traditionally associated. Second, other types of data used in these systems, while they are not monetary or perhaps even financial in nature, are still handled in a manner similar to financial data. The example, included in Appendix B at the end of this chapter, of a proposed augmentation of the fuel inventory system for Midwest Utility clearly supports the argument that the functions of gathering, processing, storing, retrieving, and reporting are essentially identical for financial and non-financial items.

A third reason for heavy involvement by accountants is the fact that they tend, as a group, to have a substantial amount of experience with this general kind of design work. The same principles that guide the design of conventional accounting systems also underlie the structuring of a good environmental information system. For instance, consider the following systems design principles taken from a popular textbook.⁷

1. Reasonable cost

⁷James B. Bower, Robert E. Schlosser, and Charles T. Zlatkovich, Financial Information Systems (Boston: Allyn and Bacon, 1969), pp. 26-49.

2. Internal control
 - a. Reliability
 - b. Organization structure
 - c. Human factors
3. Data and information flow
 - a. Data accumulation
 - b. Data processing
 - c. Report
4. System utility
 - a. Flexible, yet uniform and consistent
 - b. Audit trail

Each of these principles could be appropriately applied to environmental information systems.

Finally, the likely requirement for an eventual audit of reports generated by the environmental information system implies a need for active involvement in the designing of the system by persons who understand and appreciate the audit function. Since many authorities agree that accountants will participate in audits of environmental reports, it makes sense to include accountants in the system design function as well.

While much of the design work pertaining to environmental information systems is and will continue to be carried out by persons from the management accounting staffs of corporations, this area represents a significant market for the management advisory services units of public accounting firms. Such systems design work is but one example of the environmental management engagements that one practitioner has claimed will provide outstanding opportunities for client service.⁸

⁸William G. Gaede, "Environmental Management Opportunities for the CPA," The Journal of Accountancy, May 1974, pp. 50-54.

Public accounting firms seem to be both willing and able to undertake these assignments.

Some observations about disclosure.--The contention was made, at the beginning of this chapter, that the same general types of environmental information that are of value for economic analysis are also needed for decisionmaking by business managers and by users of published reports. In order to support this argument, some attention will now be given to the proper bases for environmental reports directed toward these three groups.

With regard to financial position data, all users have an interest in the investment and depreciation costs of abatement equipment. These items are most useful for decisionmaking if they are based upon current rather than historical values. (However, a substantial case can be made for supplying historical costs to managers, as supplementary information: historical costs enter into managerial decision-making through income tax and investor-reaction considerations.) Moreover, information pertaining to the structural components of the cost-of-capital to a firm is also desirable.

Considering next the data that concern the activities of a firm during a period of time, that is, data in the income statement or in the statement of changes in financial position; all users need an understanding of the specific nature of each material cost item. Cost behavior, in terms of systematic variation with changing levels of activity in both the short and long runs, should be made clear. Similarly, disclosure

of the segment of the firm to which each cost can be directly traced, as well as the extent to which each item is "essential" to the firm's productive activities, should be clearly disclosed. Finally, information about foregone alternatives (opportunity costs) should be included in these reports.

Each of the three groups--economic analysts, managers, and "outside" users--has a different need for detail. However, in addition to requiring the same essential sorts of financial data, each group needs narrative material. Such things as the nature of individual cost factors cannot be completely communicated by the exclusive use of the statement format. Furthermore, much of the specific financial data is not fully useful unless there is accompanying disclosure of the underlying company goals and policies with regard to environmental disruption and abatement.

In the next chapter, consideration will be given to the extension of the independent auditor's attest function to environmental reports of the sort described above as well as to special reports, of a more narrow nature, made to government agencies for regulatory purposes.

Appendix A: A Management Information System
for a Government Agency⁹

The following material is an outgrowth of interviews with several persons at the Wayne County Air Pollution Division. This discussion is included here as an example of the systems design work that accountants might perform within government agencies.

Recently, within the Air Pollution Control Division, there has been an increased emphasis on the administrative aspects of its operations. This direction reflects two key circumstances. First, most of the sources of air pollution within Wayne County are now under control, and the major problems that remain have been identified and studied. Second, with the basic machinery for the enforcement of its regulations in order, the Division is no longer operating in a "crash" setting where virtually all attention must be directed towards establishing procedures needed to meet deadlines. Accordingly, the Division can now devote more effort to improving the administration of its duties. One improvement that is envisioned is a refinement of the Division's information processing and usage, or, in other terms, the development of a modern, adequate,

⁹The author acknowledges a special debt to Mr. Pat Garvey, Systems Analyst for the Division. While Mr. Garvey's observations certainly prompted the writing of this appendix, he is not responsible for any blunders that might be present.

management information system. In this section, the desirable features of such a system for the Division will be identified.

Building a data base.--The complete emissions inventory for Wayne County, containing data about each individual source, would serve as the foundation for the data base. Of course, this data must be accessible for a number of purposes. Hence, a great deal of thinking must underlie the coding patterns implemented. For instance, key factors might include (1) type of pollutant emitted, (2) type of industrial or commercial process, (3) physical characteristics of plant (such as stack height), (4) ownership, (5) location, and (6) methods of abatement in use. While illustrative, this list is by no means exhaustive. The central consideration is the development of a data structure within which any combination of the key factors may be referenced explicitly.

With this emissions inventory stored "on the system," updates could be readily obtained from two sources. Data would be furnished both by the individual firm and by the Engineering Section of the Division in connection with each application for an Installation Permit or a Certificate of Operation. Also, data would be provided by an inspector from the Division on the occasion of an annual inspection for the purpose of renewing a Certificate of Operation.

Violation processing.--The information system could be made an integral part of the handling of violations and

public complaints. One benefit from such integration might be the possibility of developing or modifying a control strategy based on the Division's experience with certain types of violations. Such a change might be warranted under several different circumstances. For example, violations might point out a deficiency with respect to a specific emission limit or technical method of control: actual operations might not conform to expectations under certain conditions. In addition, experience with violations might demonstrate the relative administrative efficiencies of various administrative approaches to control.

In order to improve both its efficiency and its effectiveness in violations processing, the Division might use its information system to prepare a "perpetual" aging analysis of violations, containing details about each violation and subsequent inspections by the Division's staff. This aging analysis would fit well with the Division's present policy of providing at least one check within twenty-four hours of a complaint. The need for rapid checks is an obvious function of the nature of air pollution problems; the situation is particularly critical with respect to complaints about odors, since odors tend to dissipate quickly.

Other features.--Many additional functions could be incorporated into the management information system for the Division; some possibilities will be discussed at this point. One obvious application would concern actions to be taken in the event of an "air pollution alert." There exists, for each

source in the County, a contingency plan to be implemented upon direction from the Division in response to an unacceptably dangerous air pollution condition. For any specific kind and degree of extreme air pollution, the computerized system could be used to designate the most efficient set of contingency plans possible. Furthermore, incremental changes in the Division's response, that is, the tightening or relaxing of emissions limits or curtailments of activities, could be automatically and continuously generated in response to a steady flow of input data concerning ambient air conditions, emissions rates, and weather changes. Such handling of air pollution alerts would not appear even to be possible without a computer-based system.

Although certainly a part of the previous application, the use of modeling and systems analysis represents an important function unto itself. The major responsibility for such work is carried by the Technical Services staff and considerable use of computing, via time-sharing, is currently being made for these purposes. However, such efforts would become more feasible and more promising if they could be integrated with the rest of the information system. For instance, although a dispersion model is now available, it could be more fully-utilized if it could access the data base directly and if it could be used interactively for decisionmaking in situations such as the air pollution alert mentioned previously. Similarly, detailed, statistical studies of many kinds could be much more readily obtained.

The scheduling of annual inspections for renewals of Certificates of Operation could be incorporated into the computerized system. Efficient schedules for inspectors could be generated and provision could be made for delaying "non-critical" inspections during unusually-busy periods.

Air monitoring data could also be fed into the data base to be made available to the entire system. At the present time, the Division has thirteen "air monitoring stations," each a trailer carrying equipment to run tests on ambient air quality. These stations could be directly connected to the computerized information system via telephone lines.

Two groups within the Division, Technical Services and Engineering, are particularly interested in technical developments concerning air monitoring and air pollution abatement. The computerized system might therefore include an index to abstracts of relevant publications.

Finally, mention should be made of the possibility of computerizing the budgetary system for the agency. Currently, the Division uses a "line item" approach to preparing its operating budget. However, elements of "program budgeting" are incorporated into the formal application made annually to the EPA in support of a Federal grant. In addition to providing such budgetary analyses as variance reports, the computerized system would facilitate the implementation of a dual-budget system: "line item" budgets would be available for dealings with the County and State governments, "program" budgets would be available for applications to the EPA, and

elements of both approaches could be utilized for internal purposes.

The above discussion demonstrates both the need for and the potential usefulness of an advanced, computerized, information system for the Division. Moreover, the nature of the systems design work that must be performed is such that accounting personnel could make substantial and useful contributions.

Appendix B: Enlarging an Accounting System
to Include Environmental Information

The majority of the environmental information that Midwest Utility requires for internal decisionmaking and external reporting may be classified as being operating or budgetary in nature.¹⁰ In this appendix, a case will be made for integrating these sorts of information with the firm's accounting system. While it is true that much of this information is not of a monetary nature--some would claim that it is not even "financial"--there are some important links to information traditionally considered to be of an accounting character. A pair of examples may serve to illustrate more fully these links as well as their implications for the design of environmental information systems.

The first example is drawn from the annual "air and water quality report" made by Midwest Utility to the Federal Power Commission. As was stated earlier, in Chapter VII, this

¹⁰See pages 186 and 187.

report includes detailed data pertaining to fuel consumed at each generating plant. One particular schedule requires the data described below:¹¹

1. For each month and for the year as a whole
 - a. Month
 - COAL
 - b. Consumption in tons
 - c. BTU per pound
 - d. Average percent sulfur
 - e. Average percent ash
 - f. Average percent moisture
 - OIL
 - g. Consumption in barrels
 - h. BTU per gallon
 - i. Average percent sulfur
 - GAS
 - j. Consumption in cubic feet
 - k. BTU per cubic foot
2. For each source of supply
 - COAL
 - b. Mine location
 - c. Quantity in tons
 - OIL
 - d. Supplier
 - e. Refinery or port of entry
 - f. Quantity in barrels

Now it should be noted that at the time a purchase or purchase commitment is made for fuel, some manager at Midwest Utility presumably has all of these data and others as well. Accounting for fuel inventories requires that physical quantities and dollar amounts be recorded. However, it would appear to be a not-too-difficult task to incorporate the additional characteristics listed under item 1. above into

¹¹Steam-Electric Plant Air and Water Quality Control Data, Part I--Air Quality Control Data, Schedule A--Fuel Quality, pp. 2-3. Headings and identifying letters correspond to those used in the actual schedule.

such records. With regard to data pertaining to each source of supply (item 2. above), a reasonably straightforward extension of the accounts payable procedures should generate such information with little ado.

The second example refers to the feedback control system needed by the environmental manager in order to assure himself that decisions are being implemented properly and that no unresolved problems have cropped up.¹² Interestingly enough, Midwest Utility's work-order system provides this very sort of control, from a financial standpoint. Furthermore, the work-order system is already automated! Would it not be reasonable to extend the work-order procedures to cover the additional types of information needed by the environmental manager?

Inspection of other requirements for environmental data of a budgetary or operating nature would, no doubt, lead to similar observations concerning close links with the conventional accounting system. When two information systems-- in this case accounting and environmental--parallel and even overlap each other to such a considerable extent, it becomes eminently reasonable to integrate them both in design and in operation. Without such integration, duplication of effort and poorer communications among the various administrative units involved become virtual certainties. In short, the accounting system can indeed serve as a basic structure for the

¹²See pages 171 and 172 in Chapter VII and also page 222 in this chapter.

recording and reporting of many types of environmental information.

X. EXTENDING THE AUDIT FUNCTION TO ENVIRONMENTAL REPORTING

This final chapter will conclude the discussion of the potential scope of accounting for environmental-decisionmaking. While the preceding chapter examined the roles for accountants either as staff members within government agencies and business firms or as consultants to such organizations; the present chapter will focus on the function of independent accountants, specifically CPA's, in helping to provide credible information to outside users of published reports. This analysis will commence by considering the motives underlying audits of environmental reports. Then, in order to furnish a concrete basis for further discussion, recommendations will be presented concerning the content of such reports. Next, the auditability of such reports will be discussed from the standpoints of the traditional "attest function" as well as lesser "levels of assurance" as recently suggested by one authority.¹ Concurrently, the manner in which such audits might be conducted will be addressed. Finally, the alternative institutional arrangements for performing these environmental audits and the nature of

¹D. R. Carmichael, "The Assurance Function--Auditing at the Crossroads," The Journal of Accountancy, September 1974, pp. 64-72.

the required standards for reporting and auditing will be studied.

After this examination of the audit function has been completed, four general questions raised by the material in this and previous chapters will be considered. In particular, recommendations will be made concerning the ways in which further research efforts might provide some useful answers.

Why Audit Environmental Reports?

The information needs of the users of published financial statements were discussed at some length in Chapter VIII.² Such users must, in general, make either or both of two determinations: (1) the likely impact of disruption and abatement on a firm's financial position and earnings prospects and (2) whether the firm's environmental policies are effective and appropriate. The same four conditions that make it difficult for a user to evaluate the quality of conventional financial statements are present also with regard to environmental reporting:³

1. There exists an actual or potential conflict between the interests of the user and the preparer.
2. The decision that is based, at least in part, upon environmental reports is of significant consequence to the user.
3. The subject matter and manner of preparation of environmental reports are complex.

²See pages 194-198.

³These considerations were detailed on pages 201-202.

4. The user is effectively separated from both the preparer and the subject matter of these reports.

As a result of these circumstances, users of published environmental reports have a definite need for some independent assurance that the reports are credible.

Current requirements for attestation.--At the present time, independent accountants must attest to certain kinds of environmental information. First, they must assess the impact of existing and planned environmental regulations on the audited financial statements. While the costs of pollution control are quite significant, so are the risks associated with continuing to cause disruption. Accordingly, the auditor cannot render an opinion on the "fairness" of a firm's financial statements without satisfying himself as to the adequacy of disclosure about environmental matters. Indeed, it has been suggested that, for some firms, the reasonableness of the "going concern" assumption may be properly questioned.⁴ In short, the CPA must consider the regulatory setting and the firm's responses to it.

The Securities and Exchange Commission has made some of these reporting obligations quite specific. Under the terms

⁴American Accounting Association, "Report of the Committee on Environmental Effects of Organizational Behavior," The Accounting Review, Supplement to Volume XLVIII (1973), p. 78.

of Accounting Series Release Number 5170, in filings with the Commission, disclosure is required of the material effects that compliance with environmental regulations may have on the capital expenditures, earnings, and competitive standing of a firm. Furthermore, disclosure is also required of expenditures that are material and may be traced exclusively to compliance. If a reasonable basis for calculation exists, estimates should be furnished of the environmental-compliance portion of the capital outlays for, as one example, the construction of a new plant. Although these disclosure requirements now pertain only to reports filed with the SEC, there is reason to believe that they may soon affect corporate reports to stockholders as well. For the SEC, early this year, proposed new requirements which would, in effect, force much of this information contained in the annual report on Form 10-K to the SEC to be incorporated into the report to stockholders.⁵ These tentative requirements include:

1. A description of the general business activities of the firm, including information about different product lines
2. A verbal summary of operations, explaining inter-period differences in revenue and expense items
3. Information pertinent to an understanding of the firm's liquidity position and working capital needs
4. CPA attestation to the financial statements for the two most recent years

⁵Securities Act Release Number 34-10591, January 10, 1974.

Moreover, the SEC proposes that proxy statements inform the stockholder that a copy of the entire 10-K report is available upon request.

While attestation to the annual financial statements sent to stockholders and to certain reports filed with the SEC is the major way in which independent accountants help to furnish credible information to "outsiders;" for those firms in the "regulated industries," accountants also attest to reports filed with such other government agencies as the Federal Power Commission or the Interstate Commerce Commission. For "power" utilities, the CPA must certify large portions of the firm's annual report to the FPC, as was discussed in the study of Midwest Utility.⁶ At the present time, however, independent accountants do not attest to such specialized reports as a company's federal income tax return or a utility's annual report to the FPC concerning air and water quality control.⁷ Thus, current requirements for CPA attestation to reports filed with government agencies provide no clear indication of whether the independent accountant might, at some future time, be called upon to certify all or portions of a firm's comprehensive report to federal or state-local environmental regulatory agencies, should such a report actually be required. Yet, if

⁶See pages 173-174.

⁷FPC Form 67. See page 174.

such reports must be audited, it seems likely that either the CPA or staff personnel from the regulatory agencies will perform this function.

The Content of Published Environmental Reports

Before discussing whether and how environmental reports might be audited, it seems mandatory to examine the likely scope and content that will be required for such reports. In general, the conclusions to be presented here are based mainly upon the previous chapters of this dissertation and the following four significant pieces from the recent literature:

1. Dilley and Weygandt's article, "Measuring Social Responsibility: An Empirical Test"⁸
2. Beams and Fertig's article, "Pollution Control through Social Cost Conversion"⁹
3. Various writings of Linowes, but most specifically, his article, "The Accounting Profession and Social Progress"¹⁰
4. The report of the AAA's Committee¹¹ on Environmental Effects of Organization Behavior

⁸Steven C. Dilley and Jerry J. Weygandt, "Measuring Social Responsibility: An Empirical Test," The Journal of Accountancy, September 1973, pp. 62-70.

⁹Floyd A. Beams and Paul E. Fertig, "Pollution Control Through Social Cost Conversion," The Journal of Accountancy, November 1971, pp. 37-42.

¹⁰David F. Linowes, "The Accounting Profession and Social Progress," The Journal of Accountancy, July 1973, pp. 32-40.

¹¹Op. cit.

Background descriptions.--Beams and Fertig recommend that a standard industry note be included in the environmental report of a firm, identifying "the major pollution control problems within the industry, the goals of the industry in abating pollution, the control standards which have been imposed and the deadlines for compliance with existing standards" ¹² Beams and Fertig further suggest that such verbal notes might be prepared periodically by the staff of the American Institute of CPAs. The inclusion of this standard industry comment would surely help to place the environmental activities of a particular firm into context. However, the use of such a note might not be straightforward in at least two situations. First, the operations of many conglomerate firms are so diverse as to preclude the use of a single note for one specific industry. Still, this problem is no different from the general difficulties encountered in attempting to interpret the financial statements for such firms: many issues remain unresolved in the financial reporting by conglomerates. Perhaps line-of-business environmental reports, each with a different industry note, might be a reasonable approach. The second circumstance inhibiting the use of a standardized industry note would involve an environmental report for an atypical firm, one

¹²Page 42.

whose industry either is not major or is not clearly defined. In this instance, the best approach might be to omit an industry note altogether.

The second part of the background description would pertain to the environmental affairs of the individual firm, and would address four topics. First, general disclosures would be made pertaining to the various disruption concerns of the firm: their natures, the physical quantities emitted of different pollutants (or other appropriate measures of disruption), and the systematic relationships between different disruption forms and the levels and types of the firm's operating activities. Second, the regulations that cover the firm's disruption activities should be described in terms of major emissions limits or compliance standards; deadlines; noncompliance penalties; and, if material, prospective or contingent aspects of regulation.¹³ Third, the general goals and specific programs of abatement for the firm should be presented, including fairly detailed estimates of time-schedules and costs to be incurred. Moreover, information concerning the firm's progress toward meeting these goals and completing scheduled projects should be supplied. Fourth, the total and overall impact of "material environmental effects on financial position, earning and business activities of the organization" should be disclosed.¹⁴ As part of such disclosure the existence

¹³ "Report of the Committee on Environmental Effects," p. 110.

¹⁴ Ibid.

of any unrecorded liabilities or contingencies should be made clear.

The environmental financial summary.--The second major part of a firm's environmental report would comprise a statement summarizing the financial aspects of abatement. This statement would include three sections, each keyed to one of the three "major" financial statements: income, financial position, and changes in financial position. Furthermore, wherever appropriate, this monetary statement would refer the reader back to the background description discussed above.

In the financial summary, environmental outlays would be listed, in the manner implemented by Dilley and Weygandt for an actual firm, and these items would be linked to the statement of changes in financial position.¹⁵ It should be noted that the schedule of environmental outlays would probably contain more detail and might be aggregated along different classifications than the "funds" statement. Accordingly, for each item in the environmental schedule that is not identical to an item in the "funds" statement, parenthetical explanation should be provided to reconcile it with the latter statement. This same approach to reconciliation would also be applied to environmental information linked to the income and position

¹⁵See the Environmental section of Dilley and Weygandt's "Statement of Funds Flow for Socially Relevant Activities" on page 69 of their article.

statements.

Environmental expenses, keyed to the income statement, should be shown basically by major lines of business, kinds of operating activities, or abatement programs of the firm. For each expense item, cost behavior and "degree of necessity" should be shown. If an expense has been incurred that is not strictly required by abatement regulations, the reasons for the firm's "voluntary" action should be made clear. Lastly, environmental assets and liabilities should be listed, on the same segmental basis as used for expenses. These items would, of course, be keyed to the position statement.

At this point, the reader should note that the recommended environmental financial summary does not incorporate either price-level adjustments or the use of current (as opposed to historical) cost as the basis for the valuation of assets. While the contention was made in the preceding chapter that these modifications could contribute to the usefulness of environmental reports to "outside" users as well as to managers and economic analysts, it seems that the confusion which might result from using principles in the environmental report that differ from those incorporated into the firm's regular financial statements could well outweigh the possible benefits to be had.¹⁶ Therefore, the use of such techniques in published environmental reports is not recommended until such time as

¹⁶See pages 225-226.

they are applied to published financial statements. However, the author considers the potential usefulness of price-level adjustments and current costs for environmental decisionmaking to be just one indication of the need for generally-accepted accounting principles to move in this direction.

Forecasted information.--Most of the information to be included in environmental reports of the type described above, as well as most of the environment-related information currently required by government agencies and generally-accepted accounting principles, is essentially historical. However, some forecasted information is required. Estimates of material, anticipated control costs must be provided under SEC disclosure provisions and probably under GAAP as well. Furthermore, the background descriptions within the proposed environmental reports certainly would contain some information on a projected basis. Then too, future circumstances often tend to affect the historical financial statements: as one example, abatement regulations may have the effect of hastening the obsolescence of a manufacturing plant, leading to a reduction in its expected useful life and increased current depreciation charges.

While some projected information might thus be included in statements that are fundamentally historical, it does seem plausible that comprehensive forecasts could be useful to all parties concerned with environmental decisionmaking. Such forecasts could contain the same sorts of information as would the environmental financial summary described above, albeit on a projected, rather than historical, basis. While some weighty

issues remain to be resolved, the notion of corporations making financial forecasts available to outsiders seems to be garnering support. There is even some feeling within the public accounting profession that independent auditors could provide some "assurance" with regard to forecasts.¹⁷ If accountants do begin to be associated with financial forecasts and if, as will soon be argued, they can extend their audit function to environmental financial summaries; there would be little reason to doubt that they might audit environmental forecasts as well.

The Auditability of Environmental Reports

The question may now be raised concerning the extent to which environmental reports of business firms, prepared along the guidelines proposed above, would be amenable to audits by independent accountants. While Dilley's research lends some tentative, empirical support to the idea that accountants might attest to these reports, much more "field work" remains to be done.¹⁸ In this study, however, an a priori attack will be employed: the form and substance of the environmental report will be compared with the general principles described in

¹⁷D. R. Carmichael, "Financial Forecasts--the Potential Role of Independent CPAs," The Journal of Accountancy, September 1974, pp. 84-86.

¹⁸Steven C. Dilley, Accounting for Externalities: Conducting a Social Audit and Preparing a Social Responsibility Annual Report for a Public Utility, unpublished doctoral dissertation, University of Wisconsin--Madison, 1972.

A Statement of Basic Accounting Theory, while consideration will also be given to how the audit might actually be performed.¹⁹

Auditing the financial summary.--Since this section of the environmental report contains financial data similar to those that appear in the regular financial statements, it should be just as readily audited as are those statements, unless some difficulties are introduced by choices concerning either the data to be included or the methods of aggregation and the amount of detail to be used. Obviously, the data in the financial summary are quantifiable, while previous portions of this dissertation indicate that they are indeed relevant to the users' needs. Moreover, the recommended format for the financial summary was developed with specific regard to its (1) being appropriate to its expected use; (2) disclosure of significant relationships, through its scheme of categorization and description of environmental items; and (3) disclosure of the circumstances under which it is prepared, through the inclusion of background information. Hence, the only principles, set forth in ASOBAT, that need be checked for applicability seem to be freedom from bias, uniformity of practice, and consistency.

In order to fulfill these three principles, environmental financial summaries must be based upon reporting standards

¹⁹Committee to Prepare a Statement of Basic Accounting Theory, A Statement of Basic Accounting Theory (Evanston, Illinois: American Accounting Association, 1960). These principles were discussed earlier, on pages 194-198.

that provide useful definitions for various categories of data. By reference to a comprehensive set of such standards, the independent auditor could ascertain whether the proper items have been included and whether appropriate aggregation methods have been applied. If these two questions can be answered affirmatively, and assuming that the reporting standards are adequate, all of the principles for financial reporting would seem to be met. The specific nature of the required environmental reporting standards will be discussed shortly.

The "attest" approach.--In light of the above discussion, it is quite reasonable to conclude that the independent auditor could perform the same function--often called "attestation"--with regard to the environmental financial summary as he performs concerning the published financial statements.²⁰ The financial summary does indeed appear to possess the attributes that the AAA's Committee on Basic Auditing Concepts deemed essential for any extension of the audit function.²¹ In particular:

1. Assertions that are quantifiable and verifiable may be deduced from evidence pertaining to the items contained in the summary. For instance, the existence of a pollution-abatement device and its

²⁰The phrase "attest function" was popularized by Herman Bevis in his article, "The CPA's Attest Function in Modern Society," The Journal of Accountancy, February 1962, pp. 22ff.

²¹American Accounting Association, "Report of the Committee on Basic Auditing Concepts," The Accounting Review, Supplement to Volume XLVII (1972), pp. 30-31.

recorded cost may be verified by physical observation and inspection of documents. Standardized definitions could be applied to determine whether the device is indeed pollution-abatement equipment.

2. The data in the summary flow from the firm's accounting information system. Principles of internal control that apply to all accounting data apply to this item in particular.
3. The set of environmental reporting standards would serve as a generally-accepted basis for evaluating the information in the summary.

In addition to these three attributes of the subject matter of an audit, the AAA committee also considered two constraints related to the performance of the audit: the competence of the auditor and the language of his report or opinion.²² If the auditor is qualified to conduct an examination of and give his opinion regarding the firm's financial statements, then he should be competent to audit its environmental financial summary as well, since it contains the same sorts of data. However, because of the specific nature of the subject matter of the summary, the auditor must to some degree rely on the technical knowledge of environmental specialists in law and engineering. As concerns his report, the auditor would essentially state his opinion as to whether the summary has been prepared in material conformity with "established environmental reporting standards." Closer looks will be taken, later in this chapter, at the role of technical experts and the nature of the auditor's opinion. At this point, however, attention must be given to the

²²Ibid.

auditability of the other portion of a firm's environmental report.

Auditing the background information: the

"assurance" approach.--In contrast to the financial summary, this part of the environmental report contains much that is descriptive rather than quantitative. Also, certain information about the nature of the firm's disruption problems and its goals and programs for abatement do tend to be more subjective than the largely-historical financial summary. Accordingly, the independent auditor probably would not be able to render the same sort of opinion on this section as he could on the summary. However, as Carmichael has recently pointed out, the independent accountant's function need not be restricted to giving either no opinion at all or "the maximum assurance of an opinion audit" ²³ Carmichael is concerned that the term "attest," as applied to the work of auditors, has developed an overly narrow connotation of placing a "stamp of approval" on a firm's financial statements. ²⁴ He contends that "rather than imposing a framework analogous to [generally-accepted accounting principles] on all forms of information, a better approach might be to recognize that not all information can achieve the same level of reliability and to charge the auditor with different levels of responsibility for various types of information." ²⁵

²³ Carmichael, "The Assurance Function," p. 68.

²⁴ Ibid., p.66.

²⁵ Ibid., p. 68.

In short, Carmichael proposes that accountants provide varying "levels of assurance" for different types of information.

In order to provide some assurance concerning the background portion of a firm's environmental report, the independent auditor must consult with legal counsel, regulatory agencies, outside environmental experts (with particular regard to the disruption problems typical of firms in this industry), and the firm's management. Further, the auditor must study internal memoranda and board minutes to satisfy himself that the firm has not blatantly misrepresented its disruption problems (both existing and potential) and its abatement goals and progress. With regard to physical measures of disruption caused by the firm, the auditor can first check with an independent expert--perhaps a consulting environmental engineer--to see that the measuring device (or technique) is both appropriate and working correctly. Then, the auditor can proceed to test, in a manner comparable to testing financial transactions, whether the data generated by that device have been recorded and summarized properly. He can study the adequacy of internal control within this segment of the firm's information system.

In his article dealing with financial forecasts, Carmichael proposes some questions that an auditor might address in order to provide assurances to users of the report.²⁶ These questions can be adapted to the independent accountant's

²⁶Carmichael, "Financial Forecasts," p. 85.

investigation of the environmental background description, particularly the information included therein that pertains to abatement goals, programs, and progress:

1. Are budgets and schedules of costs incurred to date accurately compiled? That is, have arithmetic and similar errors been avoided?
2. Are all the data presented consistent with each other?
3. Are the principles upon which these schedules were prepared consistent with both generally-accepted accounting principles and the manner of presentation used in the firm's regular financial statements and in its environmental financial summary?
4. Is there adequate disclosure of the uncertainties associated with the projections being made?

Institutional Arrangements for Performing the Audit

The general conclusion that can be drawn from the previous section of this chapter is that environmental reports of business firms are amenable to the audit process. Moreover, independent accountants could attest to the financial summary portion of such reports and provide a somewhat lesser degree of assurance concerning the background description. In the following paragraphs, attention will be paid to the alternative institutional arrangements under which these audits might be conducted.

The CPA audit.--In discussing the auditability of environmental reports, the previous section of this chapter considered explicitly the standpoint of the independent CPA. One of the critical questions that arises in connection with this

approach is the role of technical experts. While the specific knowledge of such persons is definitely needed, it is not clear whether their relationships to the independent auditing firm should be that of employees or outside consultants. Use of an outside consultant would probably require the auditor to assume some responsibility for his work, but with the entire subject of the auditor's legal liability currently a topic of considerable debate, neither arrangement has a readily-demonstrable advantage. Perhaps the approach to be followed will actually depend upon the sheer volume of environmental audit work done by a CPA firm. Firms engaged in substantial amounts of such work would probably recruit or develop in-house experts. Other firms would likely turn to consultants.

A second question germane to the CPA audit of an environmental report concerns the actual and perceived relationship between this audit and the conventional financial audit. If environmental reports become required, either under SEC disclosure rules or generally-accepted accounting principles, their being audited would constitute a straightforward and necessary enlargement of the financial audit. Even under these circumstances, many CPAs would no doubt be reluctant to extend their role to embrace the audit of the environmental report--particularly the background description section--for fear of impairing investor confidence in the financial audit. Certainly, the user of published reports would be asked to distinguish between at least two different levels of assurance. However, this degree of sophistication is not too much to expect of users. Moreover,

the expanded wording of the auditor's report, with emphasis on the different types of assurance being given, may actually serve to better convey the true meaning of the attest and assurance functions.

If environmental reports are not specifically required, but rather are provided voluntarily by business firms; and if the standards for the preparation of such reports are not as sharply defined as they would be for required reports; it is very likely that the audit personnel of CPA firms would refrain from becoming too closely associated with the audits of environmental reports.²⁷ Instead, the management services staff of the CPA firm may "run" the audit, using the audit staff's review of financial aspects of the environmental report as part of the basis for an audit opinion. Here some valid questions might arise concerning the auditor's independence with regard to both the financial and environmental audits. Further, the distinction between the audit and management services functions within a CPA firm may become blurred. While these worries are quite real and have been discussed by others, they do not seem to be insoluble.²⁸

²⁷If a sufficient number of firms voluntarily prepare environmental reports, before long reporting guidelines will probably be established by either the SEC or the FASB. In all likelihood, a requirement that such reports be prepared by all firms would soon follow.

²⁸See Carmichael, "Financial Forecasts," p. 86. Also see "Report of the Committee on Environmental Effects," p. 114.

The social audit approach.--An alternative to extending the scope of the CPA's audit to embrace environmental reporting would be to have a separate examination conducted along social auditing lines. It is crucial to note, however, that the characteristics of social auditing have not yet been specified clearly. At one extreme, a social audit might be made of an environmental report prepared by management; such an approach might be little, if at all, different from the CPA audit of a voluntary report, as described above. On the other hand, a social audit might comprise the preparation of a report by the social audit team with the goal of stating an opinion concerning the firm's good-citizenship or social responsibility pertaining to its environmental affairs. While the CPA firms might find no serious problems in becoming involved with social audits of the former type, they probably should avoid those of the latter. For instead of giving his professional opinion about the "fairness" of a firm's statements, a social auditor in the second situation might be stating his conclusions about the firm's actions. Such a function would be closer to the financial analysis often furnished in investment newsletters than it would be to financial auditing. It is hard to imagine a CPA firm distributing its own buy, hold, and sell recommendations for the securities of various firms, including some which it serves as auditor! By analogy, serious doubts about the CPA's independence would surface if, in addition to conducting

financial audits, he became associated with "social responsibility judgements."

While the extent of involvement by CPAs should accordingly depend upon the specific nature of the social audit to be conducted, accounting expertise would be required regardless. In any social audit of a firm's environmental activities, much financial data must be considered, the data-processing system must be evaluated, and auditing techniques must be applied. At the minimum, a trained accountant should help supervise the audit. In all likelihood, an accountant should be the leader of an interdisciplinary audit team, as suggested by Linowes.²⁹ If CPA firms do not become involved, perhaps independent social auditing firms of some sort will be developed.³⁰ Whatever the structural arrangements, accountants must participate in social audits.

One last observation may be made here concerning the content of a social responsibility-environmental report for a firm. Under both the Dilley-Weygandt and the Linowes approaches, only those environmental expenditures that are not specifically required by existing regulations would appear in the statement. As Linowes states: "Such expenditures required by law . . . would not be includible since they are necessary costs of doing business." While it is important that the "degree

²⁹Op. Cit., p. 38.

³⁰This possibility is noted, with some favor, in Dilley, op. cit., p. 89.

of necessity" for each of the environmental expenditures be disclosed--this was one of the provisions suggested earlier for the environmental report--the omission of "required" items might tend to convey an improper impression of the full scope of a firm's environmental activities. Perhaps in the context of a full "social responsibility operating statement;" covering such social concerns as environment, employee health and safety, product safety, minority hiring, and others; the restriction of including only "voluntary" items is appropriate. However, in constructing a comprehensive environmental report, voluntary and required items must both be presented, although they should be distinguished from each other.

Government auditors.--If environmental reports, submitted by individual firms, are to be used for governmental decisionmaking pertaining to setting and enforcing environmental regulations, an audit may be required. One possibility is to have government employees perform this audit. To be sure, governmental auditors now examine government agencies, tax returns, and regulated firms such as banks and insurance companies. However, even though physical inspections of abatement devices and other such checks are now and will continue to be performed by government personnel, it is not likely that there will ever be comprehensive government audits of the environmental reports of firms. Dilley has pointed out that "social and political pressures" would tend to prohibit such undertakings and that "the job of preparing such social responsibility statements

would probably be too large and too expensive to meet with the approval of federal and state legislators."³¹ Long before a government agency would develop its own audit staff to perform such an examination, it would be likely to require CPA certification of the firm's environmental report.

Environmental Reporting Standards

The preceding investigation of the auditability of environmental reports, as well as the manner in which such audits might be conducted, leads naturally to a discussion of standards for the preparation of these reports. Accordingly, this section will survey the nature of the required standards and the ways in which they might be developed. These considerations apply most specifically to environmental reports audited by CPAs.

The types of standards needed.--In order to determine just what should appear in the background description portion of a firm's environmental report, the independent auditor will have to refer to specific guidelines established by some authoritative body. Moreover, throughout the report, standardized terminology must be used; comprehensive environmental reporting represents an innovative concept and its terminology is both unrefined and ambiguous.

³¹Ibid.

Thornier problems involve the establishment of categories for environmental costs. A primary question to be resolved is just what should be considered as an environmental expenditure? In essence, a generally-accepted definition or set of definitions are required. Furthermore, rules must be formulated for the treatment of joint costs, common phenomena in abatement programs. There does seem to be a consensus on the theoretical superiority of the incremental cost approach, as in calculating the additional expenditures associated with building a smokestack twenty feet taller than is essential to the "basic" operation of a new power plant, in order to comply with environmental regulations.³² Often, however, a "new facility may not be available without the additional environmental control components" and thus, "the solution [to the joint cost problem] could well be that no allocations are appropriate."³³ If such a condition does exist, how should it be disclosed in the firm's environmental report? Other reporting problems concern the circumstances under which liabilities or contingencies should be disclosed, whether a pollution control cost should be treated as a product or period cost, and whether losses related to such events as the early retirement of a plant because of its inability to meet

³²For instance, see "Report of the Committee on Environmental Effects," p. 104. This approach was also suggested by accounting personnel at "Midwest Utility" (see pages 188-189).

³³"Report of the Committee on Environmental Effects," p. 104.

environmental standards should be shown as operating or extraordinary items. All of these considerations have counterparts in the conventional financial reporting of business firms. Once again, some authoritative body must set the groundrules.

Who will set the standards?--Government agencies that regulate either environmental disruption (such as the EPA and state air quality agencies) or industries (such as the FPC and state public service commissions) generally prescribe certain practices to be followed in preparing reports to be submitted to them, but they do not set public reporting principles in general. The SEC with its broad authority, could conceivably develop specific environmental reporting standards. Yet, this area represents both a significant challenge and an important opportunity for the public accounting profession: these standards could reasonably be set by the Financial Accounting Standards Board. Such an arrangement would be especially beneficial because of the large overlaps between environmental and financial reporting. The principles underlying these two functions must be consistent! As a procedural suggestion, this author would encourage the AICPA to appoint a broad-based commission, structured along the lines of the recent "Wheat" and "Trueblood" study groups, to develop tentative principles for environmental reports. Eventually the FASB could adopt the actual standards, upon completing its formal proceedings.

Once environmental reporting standards have been established, the AICPA's Committee on Auditing Procedure could set general guidelines for conducting environmental audits. The evidence required, the technical competence of the auditor and his reliance on independent environmental experts, and the wording of the auditor's report are perhaps the three major subjects that this committee would have to deal with.

Recommendations for Future Research Efforts

This dissertation has raised certain questions that can and should be tested empirically. These issues will be stated and explained briefly below.

How can a firm's accounting system be modified

to provide environmental reports?--In an appendix to Chapter IX, a proposal was made for integrating Midwest Utility's environmental information (of an operating or budgetary nature) with its formal accounting system.³⁴ A specific illustration was provided, dealing with accounting for the firm's fuel inventory. However, the precise manner in which environmental information can be integrated into the accounting system remains to be demonstrated. Someone should actually try to do it!

Preparation and audit of an actual

environmental report.--Another research project that

³⁴See pages 232-235.

might be undertaken would comprise an attempt to prepare an environmental report in accordance with the guidelines presented in this chapter. Furthermore, an audit of this report could be tried. Such an effort is likely to help specify environmental reporting standards in addition to proving the feasibility of reporting and auditing environmental information.

Is the information contained in the environmental report useful?--If the reports accountants prepare are not useful to decisionmakers, why continue to prepare them? There is a real need to establish the usefulness of environmental reports to economic analysts, managers, and outside users. While this dissertation does provide conceptual arguments supporting the proposition that environmental information of the kinds mentioned in this and the previous chapter should be useful, some empirical evidence must be obtained. Studies could be set up to furnish reports to users and see whether the users can and do employ them in making decisions.

The broad conceptual framework developed in this dissertation as well as the conclusions presented should, hopefully, aid the investigation and resolution of these and other issues. This writer is convinced that various decisionmakers really do need environmental information and, furthermore, that persons with backgrounds in accounting can definitely help to make useful information available.

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