

Pollution and Environmental Control

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Pollution of the earth's environment (air, land, and water)—and indeed pollution of man himself—is not new. But the magnitude and intensity of the problems have become so much greater in recent years that they have blossomed into major political issues at the local, state, and national levels. The problems have also generated conflicts penetrating all segments of the economic system. Some students believe that we are rapidly approaching the point of no return, when damage to the environment could become so serious that a marked deterioration in the quality of life could occur, ushering in further deterioration at a rapidly accelerating pace.

The economics of environmental control is rooted mainly in the problem area generally described as the dichotomy between social costs and individual costs. The fundamental economic considerations of this problem area, described later, are relatively straightforward, but the practical solution to specific cases can be quite complex. Moreover, attempts to cope with problems associated with environmental control frequently challenge cherished beliefs held by some to be fundamental to the American way of life. While everyone is in favor of improving the quality of life, the consensus becomes fragmented when specific paths to the goal are proposed. Fortunately, despite all the apparent confusion and conflict, there seems to be some progress by individuals, private groups, business firms, and governments toward reducing the damage being wrought to the environment. Whether the actions taken will be timely enough and substantial enough to cope adequately with the situation is still open to question.

Almost any threat to the environment can be traced back to the way in which goods and services are produced

and used. As so aptly put by Pogo: "We have met the enemy, and he is us." It cannot be overemphasized that the key to the control of pollution involves changes in behavior, ultimately based on changes in the values held by individuals. Behavior may be modified by use of the carrot (subsidies), by the stick (taxation), by the legal system in its full range from proscriptions enforced by fines and prison terms to licensing and regulation, and finally by self-imposed rules of conduct initiated through a change in values. In the long run, some observers forecast that "the chief product of the future society is destined to be not food, not things, but the quality of the society itself. High on the list of what we mean by quality stands the question of how we deal with the material world, related as that is to how we deal with one another."¹

At the present time, efforts to deal with pollution problems place heavy emphasis on governmental action (Federal, state, or local and, in some cases, international agreements) in the form of new "rules of the game" primarily for production and waste disposal. The agent for implementing these new arrangements often will be some governmental agency itself; when standards are set, however, action necessary to meet the standard is likely to fall at the door of the private sector; for some pollution problems, there may be a partnership of different levels of government, together with the private sector.

One of the major uncertainties is how much pollution-control efforts will cost the government (Federal, state, and local) and the private sector (business firms and consumers). As noted in the section on the costs of pollution control, it has been estimated that about \$4 billion per year will be required for new investment and operating expenses in the area of water pollution. While

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¹ Max Ways, "How to Think About the Environment", *Fortune* (February 1970), page 166.

estimates for coping with other forms of pollution (air, solid wastes, noise, pesticides, and radiation) are much less firmly grounded than those for water pollution control, it is not uncommon to find estimates for coping with all forms of pollution problems over the next five years in the range of \$50-70 billion. Of course, these estimates must be viewed as very tentative, since they cannot take into account the new sources of pollution that are being uncovered and the technologies for pollution abatement that are far from fully developed.

Environmental control efforts clearly will have a substantial impact on the product mix and on the standard economic indicators now used to measure the performance of the economy. As a first approximation, these efforts can be expected to make the standard economic indicators look as if the economy is not performing as well as it has in the past. Such apparently unfavorable consequences of environmental control efforts only point up the deficiencies of our current statistics, a problem discussed in the final section.

ANALYTICAL FRAMEWORK

In a free market economy, consumers and producers choose among goods (and services) on the basis of relative prices of the goods and their usefulness. Changes in relative prices, reflecting supply conditions and market demand for goods, serve as signals for producers to increase, maintain, or reduce output, and this promotes an efficient allocation of resources. However, an efficient allocation of the factors of production presupposes that the prices of goods include their full costs of production. In the case of goods produced under conditions giving rise to pollution problems, the market price typically does not reflect the full costs of production to the economy as a whole. Such goods are underpriced in the marketplace relative to other goods not producing pollution. In effect, some industries produce a joint product—a marketable product and a nonmarketable one, i.e., pollution. The pollution product not only has no market price but it is ordinarily bestowed as a "gift" on individuals or businesses other than those buying the marketable product.

The unsought gift of the pollution product is usually discussed in economics as the dichotomy between individual (i.e., private) and social costs.² Individual costs are

those that the firm cannot avoid incurring in producing its product; the social costs are those which are not borne by the producer. Industries giving rise to such dichotomies are those in which at some point in the production process wastes are discharged into the air or a stream. These wastes impose a cost on others, by polluting the air or water supply of persons further downstream or creating additional cleaning and health costs for residents in the neighborhood of the factory.

In the past, environmental damage tended to be local in character and individuals or firms might escape at some reasonable cost. Moreover, the amount of pollution was so small that the recuperative powers of nature could repair much, if not all, of the damage done to the environment. Today, there is a new dimension to the pollution problem; it has been transformed from a local and a regional to a national and even international problem, and in its more extreme forms nature no longer can cope with (neutralize) the volume of the pollutants. Thus, the pollution problem as now constituted ranges from the older form with a more or less local impact to the present form in which there appears to be no escape anywhere on earth.

ALTERNATIVE MECHANISMS FOR COPING WITH ENVIRONMENTAL PROBLEMS

One sign of the coming of age of the pollution problem as a major concern of the nation can be found in the 1971 annual report of the President's Council of Economic Advisers, which devotes nine pages to a review of the problems of safeguarding the environment. The report emphasizes that "a set of rules for the efficient use of air and water should not only permit no more fouling of air and water than we wish to tolerate, but it should also ensure that the tolerated degree of pollution occurs for the most productive reasons. The rules should also encourage the use of resources to limit the damage done by the pollution that is allowed."³

The question is sometimes raised as to why industry does not voluntarily shoulder more of the burden of pollution control, why it is not more socially responsible. Although some firms have taken important steps involving substantial investment costs for pollution control, such efforts by individual companies are likely to fall short of adequately coping with the pollution problem. The reason for this has been stated forcefully by Professor Milton Friedman: "... there is one and only one social respon-

² The dichotomy between individual and social costs is important in the analysis of problems other than pollution. Economists generally use the term "externalities" to identify the underlying analytical characteristics shared by this group of problems.

³ *Economic Report of the President* (February 1971), page 115.

sibility of business—to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud”.⁴ The Friedman position then would place the burden on government to revise the rules of the game, as reflected in the changing public value systems, so that all firms in an industry and all industries would be required to reduce pollution products to tolerable levels.

Friedman's view, however, is being subjected to increasing challenge as too narrow by various groups within the nation, including businessmen. Clearly, attitudes about the appropriate role of corporate social responsibility are in a state of flux. The divergence in views probably would be reduced appreciably if government regulations transform much of what is now a question of corporate social responsibility into a question of corporate legal compliance. In addition, market forces reflecting consumer choices and investor decisions also will participate in determining how business adapts to the outer limits set by government.

Since damage to the environment arises from many different sources and takes many different forms, proposed methods of coping with the problems also vary. In general, the economic approach seeks to transform the social costs of production and marketing to individual (private) costs, so that the price of every marketable product will reflect its full costs of production to the economy. Some of the major suggestions for achieving this objective fall into the following categories.⁵

TAXATION OR IMPOSITION OF EFFLUENCE CHARGES. Firms or industries could be taxed according to the social costs they impose on society, assuming that the pollution damage caused by each firm or industry can be determined accurately. The tax might be levied in the form of an excise tax per unit of output or sales, or it could take the form of a charge on the amount and type of harmful effluence discharged by the firm into the air or waterway.

The goal would be a tax or effluence charge equal to the cost of the damage to the environment, so that the price of a product would reflect all of its costs of production. The higher price should decrease the amount of the prod-

uct demanded. The tax or effluence charge should serve also as an incentive to firms to find methods of production which would reduce pollution damage in an effort to minimize their tax or effluence charge. Thus, the proposed tax on lead in gasoline, even though it was not enacted, together with the standards established for automobile exhaust emissions, has spurred oil companies to speed the introduction of lead-free or low-lead gasoline.

The revenue from the tax or effluence charge could be used to construct facilities to reduce the damage to the environment by the particular industry or firm. In the Ruhr Valley, for example, effluence charges were successfully used to build facilities that upgraded the water quality of the river and that also served as an incentive for individual producers to modify their production methods to lower their charges. Regulation of charges and operation of joint facilities for the water supply in the Ruhr, which is both highly industrialized and heavily populated, is under the jurisdiction of seven large water resources cooperative associations.⁶

SETTING STANDARDS FOR WASTE DISPOSAL. Standards could be set for product performance and also for levels of harmful waste disposal (liquid, solid, or gaseous) which would reduce or eliminate the damage from the waste product. Acceptable levels could be established and a deadline for meeting these standards could be set. If a product could not meet the standard, then its production would be illegal. For example, the Federal Environmental Protection Agency (EPA) announced national air quality standards on April 30, 1971, covering six common classes of pollutants—sulfur oxides, particulate matter, carbon monoxide, photochemical oxidants, hydrocarbons, and nitrogen oxides. The agency indicated that drastic changes may be required in commuting habits and in industrial practices if the standards are to be realized by the deadline on July 1, 1975.

The setting of standards, without prescribing the precise device or machine to be used, would tend to promote individual initiative to find the least-cost solution for meeting the standard. On the other hand, there would appear to be no incentive to develop a device which reduces pollution below the levels of the standard. Of course, over

⁴ Milton Friedman, *Capitalism and Freedom* (Chicago: University of Chicago Press, 1962), page 133.

⁵ Since some Federal, state, and local governmental units also contribute substantially to pollution, many of the suggestions described in this article for coping with the pollution problem also can be applied to these units.

⁶ For further details on the Ruhr Valley water management operation, see Allen V. Kneese, "Water Quality Management by Regional Authorities in the Ruhr Area", in Marshall I. Goldman, *Controlling Pollution* (Englewood Cliffs, New Jersey: Prentice Hall, 1967), pages 109-29.

time, the standards could be changed as new knowledge is acquired.

SUBSIDIES. The introduction of pollution-control devices and techniques could be encouraged by subsidies from government to private firms and other governmental units. Subsidies may take a variety of forms: (1) direct payment of all or part of the cost of control devices or systems; (2) reduction of taxes via tax credit, accelerated amortization, reduced assessment, etc.; and (3) direct loans at preferential interest rates, guarantee of loans for special purposes, etc.

In general, if a subsidy is to be used, the direct payment, or use of the expenditure side of the budget (rather than the tax side of the budget), is preferable in facilitating evaluation of the cost of the subsidy and the benefits sought.

OTHER APPROACHES. A number of other approaches have been suggested to prevent continuing deterioration of the quality of the environment, some of which overlap the categories already mentioned. These include the recycling of wastes and the preservation of links to nature.

Recycling of wastes. The basic idea here is to view waste products as a resource or raw material. This not only decreases the drain on the still available supplies of raw materials but also may make pollution control profitable. For example, centers for recycling newspapers, cans, and glass bottles have already been established in many urban and suburban areas by civic or governmental units and by private companies or trade associations. In part, the pressure for developing technologies making recycling economically feasible can be attributed to attempts to avoid the costs imposed through legislation, as discussed above. A significant element, however, in the success of these ventures thus far has been the growing concern by individuals and business firms that such efforts are important and necessary.

Preservation of links to nature. It is necessary to set aside national parks, national forests, national seashores, national prairies, etc., and to maintain conditions for the survival of the animal and plant life that has evolved with man over millions of years, because each species or ecosystem may provide a clue to answer questions that man has not yet learned to ask.⁷ Man rather blithely introduces

changes in his life the full consequences of which he does not know and often can hardly guess. Repeatedly, he has proclaimed a miracle drug, pesticide, or other product to solve some problem, and for a time it appears that he has accomplished wonders. Later, as the miracle substances work their way through the intricate chain of interrelationships that exist on this planet, the miracle achievement no longer glows. The experience with the widespread use of DDT is an apt illustration of this process. There is the need to preserve the earth's unreproducible environmental treasures, and for each new miracle product that man produces there is the need to "go slow" and to subject it to more critical evaluation and testing.

The foregoing discussion of "solutions" for protecting and improving the quality of the environment has focused on economic answers appropriate to problems originating in the production of goods and services or the handling of waste products by the private sector and governments. However, there are a number of important threats to the quality of the environment, which stem from sources other than those usually discussed.

One of these environmental threats arises from the use of pesticides in agriculture and for the prevention of disease in the developing countries. The solutions listed above, nevertheless, are still appropriate in some combination to help cope with such problems. For example, pesticides causing less harmful environmental damage are available as substitutes for DDT even though they may be more costly; a combination of direct regulation (such as licensing the purposes for which DDT may be used) and subsidy programs to offset the higher cost of DDT substitutes might limit the damage attributable to the current widespread use of DDT.

Another threat to environmental quality emerges at the stage of final consumption, such as detergents with non-degradable components which are harmful to water supplies. The chemical composition of such products can be modified under direct regulation or licensing requirements. For example, local communities scattered throughout the nation recently have banned detergents containing phosphates.

All levels of government have begun to move more vigorously in the field of environmental protection. At the Federal level, two organizations established in 1970 divide the major responsibilities. The Council on Environmental Quality (CEQ) is concerned with broad policy questions, including the coordination of all environmental quality programs and the review of other Federal programs that affect the environment. Moreover, all Federal agencies are now required to file with the CEQ (and to make public)

⁷ This proposal is discussed in John G. Mitchell, "On the Spoor of the Slide Rule", *Ecotactics* (New York: Simon and Schuster, 1970), pages 23-35.

a statement giving in detail the environmental implications of all legislative proposals and of other major activities with a significant environmental impact. (Some of these reports have received wide publicity, e.g., the report by the Department of the Interior on the proposed construction of an oil pipeline in Alaska.) The other agency, the EPA, is primarily concerned with enforcement and was formed by gathering into one organization functions that had been scattered among several departments and independent agencies. As noted earlier, the EPA recently promulgated national air quality standards to be attained by 1975.

At the state and local levels, new environmental agencies have been established or existing agencies have been reshuffled and renamed, sometimes with added responsibilities. Last year, New York State consolidated many of its existing environmental programs into the Environmental Conservation Department and broadened its jurisdiction. In New York City, where environmental problems are particularly acute, a new superagency—the Environmental Protection Administration—was established in 1968 by combining many of the programs of four formerly separate departments (sanitation, water supply, air pollution, and public works). While the new organization still renders the municipal services that the old departments had supplied, the environmental protection aspects now are given more stress than previously.

THE COSTS OF POLLUTION CONTROL

The costs of coping with pollution problems are going to be tremendous. Comprehensive estimates must be considered tentative, because we have barely scratched the surface of understanding the dimensions of the environmental problem. "Environmental pollution is not an incidental by-product. Rather, it is an intrinsic feature of the very technology developed to enhance productivity. This technology is so imbedded in the agricultural and industrial production processes that the required change would involve serious economic dislocations."⁸ The dilemma we face is how to enjoy the fruits of science and technology and at the same time safeguard the natural world we live in.

Any assessment of the question of the costs of pollution must keep in the forefront the fact that someone already is paying for the costs of pollution because pollution damage falls somewhere. At the present time, however, the dis-

tribution of this pollution cost is inequitable, since it is often "paid for" by persons or industries which are neither polluting nor buying and using the marketable products produced jointly with the pollution products. To a substantial degree, the costs also are imposed on future generations. The objective of transforming the social costs of production and marketing to individual costs is, in part, an attempt to put the costs where they truly belong. Shifting to a more equitable distribution of the costs of production clearly will involve some difficult transitional adjustments, especially for those industries—such as paper and copper mining—that generate a substantial amount of pollution products along with their marketable products. As noted previously, a successful attack on the pollution problem will require changes in the rules of the game via government regulation to insure that pollution problems are attacked on a sufficiently wide front to make a difference. Even though part of the pollution-control costs during the transition will be met by the general public through some form of government assistance, the adjustment will still require heavy investment spending by some segments of private industry and possibly higher prices for some marketable products. Since these costs may impair the profitability of an individual firm, it is not surprising that specific pollution-control proposals are not always embraced with enthusiasm by the firm or industry affected.

Although the cost aspects of coping with the pollution problem by industry are scarcely a topic giving rise to joy, there is a positive side to this cost picture. Products to reduce or eliminate pollution will constitute a new industry, generating employment and profits, not to mention the better quality of the environment that will benefit all. Moreover, a full-scale attack on pollution problems could actually minimize our eventual costs. In economic terms, while costs will rise substantially in the short run, they will be smaller in the long run if the attack on the pollution products is not postponed.

In the remainder of this section, cost estimates for different types of pollution will be summarized.⁹ These estimates are only rough approximations, as we know so little about the full ramifications of the problems and the technologies to deal with them. Cost estimates for specific pollution problems often span a wide range, since each analyst may build his estimates on different assumptions as to what is necessary, desirable, or possible.

⁸ Barry Commoner, "The Social Significance of Environmental Pollution", *Business Economics* (January 1970), page 70.

⁹ The cost and volume estimates presented in this section are based mainly on information contained in *Environmental Quality*, the first annual report of the Council on Environmental Quality, transmitted to the Congress in August 1970.

WATER POLLUTION. The problem of water pollution has received more attention over a longer period than other pollution problems. Estimates for coping with water pollution, therefore, are more solidly grounded, but even these are subject to considerable uncertainty. It has been estimated that industrial outlays for the control of water pollution in the period 1971-74 will run in the neighborhood of \$1.2 billion to \$1.4 billion per year, about half for new investment and the other half for operating charges. Municipal waste-treatment plants will require about \$2.0 billion of new investment per year and an additional \$500-700 million for operating expenses. (Estimates are not available on how much investment will be needed for additional collection and treatment facilities.) Thus, the annual costs for both industrial and municipal outlays total an estimated \$4 billion.¹⁰

AIR POLLUTION. Only the more obvious forms of air pollution have been identified thus far. Consequently, little is known about the full costs of air pollution abatement except the rather safe guess that they probably amount to many billions of dollars. At the present time, the most important sources of industrial and municipal air pollution arise from particulate matter, sulfur oxides, hydrocarbons, and carbon monoxide. For these four types of pollutants, it is estimated that an investment of about \$2.6 billion will be needed in one hundred metropolitan areas of the United States through 1975. Operations, maintenance, depreciation, and interest will cost another \$1.9 billion.

SOLID WASTE. In 1969, residential, commercial, and institutional solid wastes totaled 250 million tons, of which 60 million tons remained uncollected. An additional 110 million tons of solid waste (other than mineral solid waste) was generated by industry in the same year. Firmly based cost estimates for handling the ever-growing

mountain of solid waste are virtually nonexistent.

The disposal of solid wastes illustrates how different aspects of the pollution problem may be highly inter-related. Burning solid waste in dumps or incinerators (especially in inefficient incinerators) adds to the air pollution arising from other sources. Similarly, land disposal may contribute to contamination of groundwater used for drinking purposes, or may breed rats and other pests.

Unfortunately, the technology of solid-waste collection and disposal has lagged far behind the capacity of the American economy to produce the waste products. The technological improvements that could ease the problem of solid-waste disposal would involve not only better methods of disposal but also methods of using the waste product in some form of recycling. For some basic minerals, recycling is now a major source of supply for new output; more than half of the lead production and almost half of the copper output comes from scrap. While recycling holds considerable promise for dealing with some forms of solid waste, other approaches will have to be devised for the sizable remainder not suitable for recycling.

OTHER POLLUTANTS. Several other forms of pollutants which do not fit neatly into any of the previous three categories have been growing in importance, such as noise, pesticides, and radiation. All of them have been present to some degree for a long time, but they have become a far more serious menace to man in recent years. The radiation danger, in particular, has tended to be underestimated because it is often thought to be confined to dangers from the nuclear bomb. In industrialized nations, however, there is increasing exposure to low-level (and cumulative) radiation from such sources as X-rays, radioactive materials used in research and industry, and electronic devices in the home, office, and industry. While these pollutants probably are exacting a heavy toll now, there are no firm estimates about the extent of the damage they inflict or the costs of reducing the pollution products.

Although it is not possible to calculate firm estimates of the costs which will be incurred to reduce pollution to a reasonable level, the preceding analysis provides some insight into the enormity of the problem. Clearly, if water pollution alone will require at least \$4 billion per year over the next five years, it is not difficult to understand why some students have suggested that costs may exceed \$70 billion in the next five years, if significant progress is to be realized in the abatement of pollution. As difficult as it is to estimate these costs, it is even more difficult to determine how these costs will be distributed between the

¹⁰ The difficulties and costs of dealing with water pollution as a domestic problem may prove relatively small, compared with the difficulties and costs of water pollution as an international problem. Jacques Yves Cousteau, the famed underwater explorer, has said: "People do not realize that all pollution ends up in the seas. The earth is less polluted. It is washed by the rain which carries everything into the oceans, where life has diminished by 40 percent in 20 years." (*Time*, September 28, 1970, page 64.) Coping with pollution in the oceans will require international agreements which are usually more difficult to achieve and implement than domestic legislation. Such difficulties may have tragic consequences for the developing countries with large populations suffering from malnutrition, because food from the oceans has been viewed as a prime resource for solving the food problems of these countries.

FEDERAL POLLUTION-CONTROL AND -ABATEMENT ACTIVITIES

In millions of dollars

Budget funding	Fiscal 1970 (actual)	Fiscal 1971 (estimate)	Fiscal 1972 (estimate)
Budget authority	1,432	1,828	3,127
Obligations	1,071	2,036	3,088
Outlays	751	1,176	2,014

Source: *Special Analyses (Budget of the United States Government)*, Fiscal Year 1972, page 219.

government and the private sector.

Since the Federal Government is a prime mover in the pollution-control field, it is interesting to note the level and growth of its commitment since fiscal 1970. Under budget procedures, the Congress grants an agency budget authority up to a certain amount; the agency then may enter into obligations to implement a program which in turn leads to actual spending immediately or at some future date. Budget projections for fiscal 1972 (see table) indicate spending almost three times greater than in fiscal 1970 for pollution-control and -abatement activities. More than half of the total spending is concentrated in the area of water pollution, more specifically in grants and loans to state and local governments for the construction of municipal waste-treatment facilities. For the other pollutants, the funds are mainly used for research on the effects of pollution, for technology, for the setting of standards, and for enforcement.¹¹

Regardless of the specific distribution of costs, there is no question that pollution-control efforts will have wide-ranging impacts on the output of the nation. We can expect noticeable changes in the product mix, accompanied by adjustments in price relationships among products. Some of the more important implications of this aspect of the pollution problem are sketched briefly in the next section for some of the more common economic indicators.

¹¹ Of course, direct spending by the Federal Government does not fully measure the extent of the Government's role in pollution abatement. Some legislation, such as the establishment of air quality or water standards, has far-reaching impacts with relatively minimal Governmental spending. In addition, as noted previously, subsidies may be provided to encourage private expenditures on pollution-control devices. In the Tax Reform Act of 1969, there is a provision to permit the rapid amortization (over a period of five years) of pollution-control devices. The costs to the Government of rapid amortization, or other types of tax subsidies, are not recorded in the budget.

IMPACT OF THE ENVIRONMENTAL CRISIS
ON ECONOMIC INDICATORS

The level of and changes in gross national product (GNP) are the most widely used indexes of how well the economy is performing. With some exceptions, GNP represents the dollar value of goods and services produced in a given period and moving through market channels. If it is to provide a reasonable measure of economic welfare, then the negative contribution of pollution products "produced" along with the marketable products should be subtracted from GNP as presently computed.¹² In short, to calculate "real" GNP, it is necessary not only to make a price adjustment for the inflation factor but also to correct for the social costs of production in each period. There is no question that such a correction would always operate to reduce the real level of GNP from that recorded in the national income statistics as they now stand.

Actually, some of the costs of the pollution product are in GNP as now calculated.¹³ Ironically, instead of making GNP smaller for any given period, as indicated above, these costs make GNP larger. In effect, GNP is a "grosser" concept than that suggested by the official explanation, where the gross aspect represents depreciation of plant and equipment. The additional "grossness" is in the inclusion of all the goods and services produced because of the disutilities arising from the pollution products, such as cleaning services and medical services which merely attempt to restore the previous level of well-being and would not have been needed in the absence of the pollution products. Estimates of health costs and pollution cleanup costs, reported in the previous section, are suggestive of the dollar magnitude by which current GNP estimates

¹² It should be emphasized that GNP was designed as a measure of output, not of welfare (used in the economist's sense of well-being, not in the social worker's sense of "relief"). Output and welfare, however, are very much interrelated, so that it is not surprising that GNP is frequently used as a proxy for welfare not only by the general public but also by economists. For a more extended discussion of this point and several others in the text of the article, see Edward F. Denison, "Welfare Measurement and the GNP", *Survey of Current Business* (January 1971), pages 13-16 and 39, and F. Thomas Juster, "On the Measurement of Economic and Social Performance", *50th Annual Report* (National Bureau of Economic Research, 1970), pages 8-24.

¹³ More technically, pollution-control activities generally are treated in three ways for the purposes of calculating current-dollar GNP. Some goods and services increase GNP, including devices treated as quality improvements in existing products; some increase the implicit price deflator and thereby are viewed as inflationary; and some are excluded from the GNP calculation, such as cleanup services by volunteers.

overstate how well the economy is doing in creating *net* new goods and services.¹¹

As the drive to reduce pollution products gathers momentum, dollar expenditures for pollution-control devices and systems will rise. It would not be surprising if in the short run, defined in this context as the next five to ten years, pollution-control expenditures increase relatively faster than total output. It is not unreasonable to expect that the introduction of recycling devices, emission control devices, and better waste disposal will stretch out the production process, making it more expensive without necessarily enlarging output of the marketable product. It is also likely that legislation providing for effluence charges and standards for product performance (such as auto emission standards) will require more and better quality control efforts by industry, which again might affect adversely some economic series, such as output per man-hour and the index of industrial production.

More generally, steps taken to reduce pollution products can be expected to have far-ranging impacts on the statistical series typically used to judge the state of the

economy. These measures now are basically quantity oriented and take account of quality changes not at all or only very imperfectly. As suggested above, statistical series are likely to be adversely affected, as more and more resources are devoted to protect the environment. For example, output per man-hour may increase more slowly or perhaps not at all; capital investment may appear to be less productive than formerly; business profits may be adversely affected if the additional costs cannot be passed on; if the additional costs are passed on, the cost of living may rise at a rapid rate and yet not reflect any actual inflationary push. It is important to consider the other side of the coin as well. Failure to begin meeting the pollution-product challenge today is likely to affect output adversely and increase costs in the future.

In effect, bringing into the marketplace, and into the standard statistical series, costs that have previously been part of the social costs of production probably will give the standard economic series a rather bleak look for a time, because these series will be measuring a very different basket of goods and services than formerly. Although the figures will look worse, they will be painting a more realistic picture than is available now of how the economy is functioning. Therefore, if pollution-control efforts should expand significantly, new guideposts will be needed to interpret what the statistical series are telling us about the economy, since the new data really will not be comparable to data in use today.

¹¹ Dr. Paul Kotin, Director of the National Institute of Environmental Health Sciences, has estimated that man's misuse of the environment is costing Americans \$35 billion a year through ill health and related losses alone (*The New York Times*, October 7, 1970, page 33).