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THE CASE FOR INTEGRATED POLLUTION CONTROL

LAKSHMAN GURUSWAMY*

I
INTRODUCTION

Professor Marcus’ article¹ has informed us of the original integrative vision of the architects of EPA. In this comment, I propose to review briefly the case for an integrated approach to pollution control ("IPC").² I shall deal with the disadvantages of EPA’s current fragmented approach, and with both the advantages and difficulties posed by implementing an integrated approach. Finally, I shall suggest that EPA can start to overcome these difficulties by adopting or developing a few practicable measures.

II
DISADVANTAGES OF THE PRESENT SYSTEM

The existing fragmented approach to pollution control is both ineffective and inefficient. The present regime concentrates on moving pollution from one place to another.³ Unfortunately, such pollution transfers ignore the

¹ Alfred A. Marcus, EPA’s Organizational Structure, 54 L & Contemp Probs 5 (Autumn 1991).
² IPC is more fully considered in a number of reports published by the Conservation Foundation. See, for example, Controlling Cross-Media Pollutants (1984); New Perspectives on Pollution Control: Cross-Media Problems (1985); State of the Environment: An Assessment at Mid-Decade (1984); The Environmental Protection Act, Second Draft (1988); Barry G. Rabe, Fragmentation and Integration in State Environmental Management (1986); Nigel Haigh & Frances Irwin, eds, Integrated Pollution Control in Europe and North America (1990). The National Research Council and the National Academy of Public Administration have studied the subject and have lent their weighty support for the adoption of an integrated approach. See Natl Research Council (U.S.), Multimedia Approaches to Pollution Control: A Symposium Proceeding (Natl Acad Press, 1987); Steps Toward a Stable Future: A Report (Natl Acad Pub Admin, 1984). In the United Kingdom, the Royal Commission on Environmental Pollution has taken the lead in advocating an integrated approach. See Best Practicable Environmental Option, Report No 12 (1988); Managing Waste: The Duty of Care, Report No 11 (1985); Tackling Pollution—Experiences and Prospects, Report No 10 (1984); Air Pollution Control: An Integrated Approach, Report No 5 (1976). See also Dept Envir (U.K.), Integrated Pollution Control (1988).
³ Laws aimed at reducing or removing pollutants from specific media focus on the symptoms or effects that take the form of pollution rather than the causes or sources that create the residuals or wastes in the first place. As a result, pollution controls do not restrict the production of goods that are the reason for the production processes causing pollution. See discussion in Part III.
basic law of physics that matter is indestructible and does not go away. The initial destination of pollutants may be altered, but pollutants ultimately re-enter the flow of material in the environment.

Limitations on discharges in one medium, such as air, while correcting the immediate pollution problem within that medium, often do little more than shift the pollution to another medium. Such transfers can create even greater problems in the medium to which they are moved. Thus, control technologies aimed at achieving specific limits to pollution often generate new streams of residuals that have adverse effects on other media.

The massive quantities of sludge created by compliance with existing pollution controls illustrate this point. The provisions of the Clean Air Act directed at reducing sulphur dioxide require the use of scrubbers in smokestacks. These devices spray huge quantities of lime, limestone solution, and water on exhaust gases as they flow up power plant smokestacks. Sulphur dioxide in the exhaust reacts with the spray and forms a solution from which sulphur dioxide is later removed, strained, and disposed of in the form of sludge. EPA has estimated that three to six tons of scrubber sludge may be produced for each ton of sulphur dioxide removed from exhaust gas. Consequently, the problem of sulphur dioxide removal is replaced by the problem of sludge disposal. Municipal wastewater treatment and sewage treatment plants also produce large quantities of sludge, some of which contains toxic substances that are nondegradable and bioaccumulable. In all, it is estimated that more than 118 million metric tons of sludge are produced annually.

The problem of direct transfers of pollutants from one medium to another, like the case of sludge, is compounded by indirect transfers resulting from physical, chemical, and biological forces. Physical processes that transfer pollutants across media include leaching, volatilization, and deposition. Leaching occurs when pollutants, particularly toxics, are


5. The Clean Air Act provided that new coal-fired electricity generators should use "the best technological system of continuous emission reduction which (taking into consideration the cost of achieving such reduction) the Administrator determines has been adequately demonstrated." Pub L No 91-604 § 111(a)(1), 84 Stat 1683 (1970). EPA has effectively determined that this necessitates the use of scrubbers. 37 Fed Reg 5768-69 (1972).

6. See Bruce T. Ackerman & William T. Hassler, Beyond the New Deal: Coal and the Clean Air Act, 89 Yale L J 1466, 1481 n56 (1980) (citing 2 EPA Pub No 600/7-78-032b).


8. Id at 9.

9. Id.

10. Id at 14-20.
dissolved and percolate or move from waste disposal sites into groundwater.\textsuperscript{11} Volatilization is the process of vaporization that shifts pollutants from land or water to the air;\textsuperscript{12} the atmosphere, for example, serves as a medium of transfer for volatilizing fertilizers and manure.\textsuperscript{13} Deposition, of which acid rain is an example,\textsuperscript{14} is the transfer of pollutants from the air to land and water. In the Chesapeake Bay, for example, where excessive nutrients such as nitrogen are a major problem, 25 percent of the nitrogen generated by human activity reaches the bay through the atmosphere. It is estimated that in 1981 air deposition accounted for 90 percent of polychlorinated biphenyls (PCBs) entering the Great Lakes.\textsuperscript{15}

In addition to these physical processes, indirect transfers may occur when a pollutant's chemical structure and toxicity changes as it moves through the environment. For example, sulphur dioxide transforms into sulfate through several different chemical processes, while sunlight acting on unburned hydrocarbons and nitrogen oxides creates smog. Finally, biological processes in which microorganisms break down toxic compounds also present new problems. For example, microorganisms can change mercury into the highly toxic methyl mercury. Consequently, toxic materials could continue to accumulate in fish even though their concentration in water has been reduced.

Congress admits that a problem exists. The findings embodied in the Resource Conservation and Recovery Act (now the Solid Waste Disposal Act) acknowledge that the Clean Air and Clean Water Acts have created problems of solid waste disposal, which in turn have created problems of air and water pollution.\textsuperscript{16} A more forceful recognition of the nature of cross-media or

\begin{footnotesize}
\begin{enumerate}
\item Acid rain, or more accurately acid deposition, primarily results from the emission into the atmosphere of sulphur oxides, nitrogen oxides, and, to a lesser extent, hydrocarbons. Sulphur dioxide (SO\textsubscript{2})—both as a gas and as a transformed product (sulfate)—which is largely produced by the burning of coal containing sulphur in power generation and smelting processes, and by the combustion of other fossil fuels by industrial, commercial, and residential users, gives rise to the greatest concern. Nitrogen oxides are emitted by the combustion of fossil fuels at high temperatures. The main sources of man-made nitrogen oxides are motor vehicles and fossil fuel power plants. See 1 Interim Assessment: The Causes and Effects of Acidic Deposition, Executive Summary 3 (Natl Acid Precipitation Assessment Program, 1987).
\item Haigh & Irwin, eds, \textit{Integrated Pollution Control} at 30 (cited in note 2).
\item The relevant language of the Resource Conservation and Recovery Act reads: [A]s a result of the Clean Air Act, the Water Pollution Control Act, and other federal and state laws respecting public health and the environment, greater amounts of solid wastes (in the form of sludge and other pollution treatment residues) have been created. Similarly, inadequate and environmentally unsound practices for the disposal of solid waste have created greater amounts of air and water pollution and other problems for the environment and for health. 42 USC § 6901(b)(3) (1982). See also Clean Air Act, 42 USC §§ 7401 et seq (1982); Water Pollution Control Act, 33 USC §§ 1251 et seq (1988); Solid Waste Act, 42 USC §§ 6901 et seq (1988). The most forceful recognition of the problem is found in the Pollution Prevention Act, 42 USCA §§ 13101-09 (Supp 1991).
\end{enumerate}
\end{footnotesize}
inter-media transfers led the British Royal Commission on Environmental Pollution to conclude that "most of the present and future problems in environmental pollution will be of this cross-media type."\textsuperscript{17} In a similar vein, the United States National Research Council has noted that "multimedia transport of pollution appears to be the rule rather than the exception."\textsuperscript{18}

Fragmented pollution controls create additional problems. Usually these regulations assess the risk of a pollutant on the basis of a single chemical causing exposure in a single medium. Regulations under the Clean Air Act, for instance, typically consider the risk of exposure from a specific source through the air. Regulations implementing the Federal Insecticide, Fungicide, and Rodenticide Act ("FIFRA")\textsuperscript{19} evaluate the risk to people who mix chemicals, spray chemicals, and eat food containing chemical residues, but they do not usually consider the risk to people who do all three.

A person may be exposed to a pollutant in any of three ways: by inhaling the substance, ingesting it in water or food, or absorbing it through the skin. Plants and animals are subject to similar exposure. For example, absorption occurs when pollutants settle on plants, or marine animals are surrounded by polluted water. Ingestion and inhalation occur when contaminated prey or food is consumed. Present environmental laws ignore the different risks posed by different types of exposure. In fact, present laws may focus on the damages of only one method of exposure and ignore other methods that pose even greater health risks. For example, a study of cadmium exposure in Montana, where inhalation exposure was the basis for limits on air emissions, showed that there was more risk through ingestion (eating contaminated food) than through inhalation.\textsuperscript{20} The bewildering and aggravated risk presented by the synergistic effects of thousands of substances present in the environment simply falls outside the pale of reckoning.\textsuperscript{21}

The present fragmented approach to pollution control is also economically inefficient.\textsuperscript{22} Currently, pollution controls may ensure that wastes cannot be discharged according to the best environmental option and may lead to inefficient use of the environment's assimilative capacity. In the example previously considered, implementation of the Clean Air Act leads to

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\bibitem{17} Royal Comm'n on Environmental Pollution, Tackling Pollution—Experiences and Prospects at § 6.35 (cited in note 2).
\bibitem{18} National Research Council (U.S.), \textit{Multimedia Approaches to Pollution Control} at 4 (cited in note 2).
\bibitem{19} 7 USC §§ 136 et seq (1988).
\bibitem{21} Synergistic effects may occur because of chemical reactions between the substances or because the presence of one substance in the body increases the toxicity of another. For example, asbestos is estimated to be about ten times more dangerous to smokers than to nonsmokers. National Research Council (U.S.), Committee on Risk Perception and Communication, \textit{Improving Risk Communication} 43 (Natl Acad Press, 1989).
\bibitem{22} Apart from the types of inefficiency discussed in the text, the present pollution controls could be inefficient in other ways. The National Academy of Public Administration has pointed out that statutory and administrative fragmentation has led to budgeting rigidities, confusion, and generally inefficient administration. \textit{Steps Toward a Stable Future} at 5 (cited in note 2).
\end{thebibliography}
the creation of large quantities of sludge. Sludge can be disposed of in a number of ways. It can be discharged into a river or directly into the sea, or piped into a lagoon to settle and dry out as solid waste. Thus, it may be the case that current air pollution requirements lead to water or solid waste disposal problems that cause greater overall damage to the environment. Setting independent standards for each medium that ignore the total capacity of the environment to assimilate pollution imposes unnecessary and unjustified costs, thereby creating economic inefficiencies.

A more efficient and cost-effective way to control pollution would be to distribute the wastes among water, air, and land in a manner that optimizes the total environment and any special or particular assimilative capacity each medium might possess. This policy would lead to a balanced approach to pollution control, avoiding the problems associated with standards that are overstringent in some areas and unduly lax in others. Significant steps in this direction have been taken already by Sweden and the United Kingdom.


24. In Sweden, the Environment Protection Act of 1969 laid the foundations for cross-media pollution control by providing that pollution should be controlled at its source. This Act replaced the existing sectoral control and states that pollution "from land, buildings or installations," whether it be in water, air, or land, or take the form of noise, should come within the Act's jurisdiction. The Act authorizes the National Franchise Board to grant permits to major polluting sources. A single permit covers discharges to air, water, and land. In deciding what the permissible limits of pollution should be, Sweden does not rely upon predetermined standards—whether they be ambient or source related—but on the best practicable technological means of control.

Even though major pollutants are regulated in Sweden according to the environmental medium of release, each waste stream is ultimately assessed according to its contribution to the totality of pollution. For example, if a waste incinerator is mandated by the permit to place filters on its exhaust stack to remove harmful residues of heavy metals from the flue gases, the technology used to accomplish this task is scrutinized very carefully. A wet process that removes trace metals but merely transfers pollution from air to water is not permitted.

Regulation of the Saab-Scania truck manufacturing plant at Osharshamn on the Baltic coast provides an example of how IPC is implemented. Under the Saab-Scania permit, emissions to air, water, and land are stipulated in one document. The entire waste or residual stream is viewed in its totality, and standards are set taking account of technology and environmental impact. Consequently, the Swedish system makes it possible to place stricter controls on some harmful pollutants (such as trichlorethylene, lead, and zinc), while being lenient on others (such as nickel) that are not seen as posing as great a threat to the environment or human health.

The Swedish experience demonstrates the possibility of applying IPC to stationary sources and reveals how single permits can be employed. Although the United Kingdom did not model its system of IPC on the Swedish structure, there is no doubt that the two systems have much in common. Both are regulated by unified environmental authorities and are based upon single permits. Technology based controls also play a key role in both countries, albeit to a lesser degree in the United Kingdom. See Don Hinrichson, Integrated Permitting and Inspection in Sweden, in Haigh & Irwin, eds, Integrated Pollution Control 165-66 (cited in note 2), on which this account is heavily dependent. See also a report by the Organization of Economic Co-Operation and Development, Environmental Policy in Sweden (1977).

In the United Kingdom, the enactment of the 1990 Environmental Protection Act marks a milepost in the United Kingdom's journey from fragmented pollution control to integration. Environmental Protection Act (1990 c 43). In essence, the British realized that pollutants have effects in media other than those into which they are released, and that reducing the opportunities to dispose of a waste in one medium often increases the need to dispose of the waste (or its modified components) in another medium. They also appreciated that the optimal disposal path for a
III

Advantages of an Integrated Approach

We have hitherto been considering the difficulties presented by a fragmented system of dealing with pollution that has already been generated by an activity or a manufacturing process. Part II described why IPC, not fragmented controls, are necessary to deal with the synergistic and cross-media effects of such pollution. This may be described as remedial IPC. IPC also can be applied before the activity or manufacturing process with a view to reducing the creation, or modifying the volume or quality of, troublesome residuals or wastes. This may be described as preventive IPC. We now consider some implications of preventive IPC.

Pollution results from the staggering range of domestic and industrial activities that maintain the astonishingly good quality of life we enjoy. The exacting demands on energy and raw materials made by these activities inflict punishing costs. Many of the comforts of modern living that we take for granted give rise to enormous quantities of wastes, residuals, and pollutants. They include the energy used for heating and cooling, and for moving rapidly by air, land, and water; the chemicals (pesticides, fungicides, and insecticides) used in producing clean, long-lasting food; and the luxurious materials used to build and furnish our homes, cars, and boats, and to attire ourselves. Long before the end of their useful life, goods are dispensed with and replaced by

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particular waste will be found only if both of these points are taken into account and the option selected is one that causes least overall damage to the environment.

As a first step toward integrated pollution control, the government created a new combined "Pollution Inspectorate" out of the existing separate inspectorates. The absence of statutory authority that empowered such a balanced cross-media approach to pollution control was acknowledged, Dept Envir (U.K.), Integrated Pollution Control at 5 (cited in note 2), but that shortcoming has been overcome by the Environmental Protection Act, the main purpose of which is to introduce "an effective cross-media approach to pollution control leading to a real and lasting overall reduction of pollution." Id at 8.

The Act modifies and extends the existing licensing system governing air pollution. The enlarged system covers a wider range of processes and types of plants, including certain discharges to water and sewers as well as some hazardous wastes. Environmental Protection Act § 2 (cited in this note). The licensing authority called Her Majesty's Inspectorate of Pollution ("HMIP") is further empowered to set specific conditions including the use of the "best available techniques not entailing excessive costs." Id at § 7(2)(a). In cases involving releases to more than one environmental medium, the conditions prescribed will ensure that pollution to the environment as a whole is minimized. The license further places a residual duty on the licensee, using the best available techniques not entailing excessive costs, to render harmless releases from any processes not covered by the specific conditions. Id at § 6. In carrying out its mandate, HMIP will ensure that no existing legislative, European Community, or international standards are breached.

The experience of the United Kingdom indicates that it is possible to bring sources and substances within a technology-based system of integrated pollution control. It also reveals how IPC could be built around existing standards. In other words, there is no need to relax or rewrite existing standards in order to establish IPC. What the United Kingdom experience further demonstrates is that the move to an integrated approach can be justified on efficiency grounds. Dept Envir (U.K.), Integrated Pollution Control at 1 (cited in note 2). It is erroneous to equate integrated pollution control with greater bureaucracy. Indeed, the United Kingdom maintains that IPC would help industry by offering a streamlined authorization procedure. Furthermore, IPC would more efficiently use pollution control resources by obviating the need for maintaining a structure based on separately regulating discharges to the three media. Id at 7-8. See also Guruswamy, 7 Ariz J Intl & Comp L at 192-95 (cited in note *).
new and different goods. We appear to be inexorably locked into a profligate cycle of waste.

The matter and energy used to satisfy our lifestyles are neither created nor destroyed; they are merely transformed. Massive quantities of wastes or residuals are, therefore, the unavoidable by-products of today's living. An integrated approach to pollution control attempts to reduce the amount of residuals and waste by questioning the importance of various products and the manufacturing processes that cause them.

An integrated approach also facilitates good management. IPC recognizes that product and process are inextricably interdependent in modern manufacturing industries. Both a product line and an associated production process must be taken together as a unit of analysis. Integration generates good management because it takes account of all relevant factors and alternatives before imposing a particular regulation. For example, an integrated approach considers inputs in the creation of residuals, while a fragmented approach, because it is concerned with effects, does not.

The relationship of inputs to residuals can be illustrated by the coal-electric industry. In a coal-burning power plant, the combustion of coal to create electricity produces sulphur dioxide (SO$_2$), oxides of nitrogen (NO$_x$), particulates, bottom ash, and other unwanted materials. The quantity of SO$_2$ generated in combustion is a function of the sulphur content of raw coal and the extent, if any, of its removal in coal processing or by washing. The extent to which the sulphur content of the coal (the input) determines the nature of the residuals has been vividly demonstrated. The reductions in the amounts

25. Wastes or residuals are used conterminously for the substances (gasses, solids, liquids) that are the by-product of a manufacturing process. Residuals or wastes that are not naturally assimilated by the environment, or neutralized by treatment, can become pollutants that cause harm to human health or the environment. Kneese & Bower, Environmental Quality and Residuals Management at 3 (cited in note 4); Rabe, Fragmentation and Integration at 15 n46 (cited in note 2); Kneese, 10 Ariz L Rev at 11 (cited in note 4); Kneese, Economics and the Environment at 16-73 (cited in note 4); Hufschmidt, et al, Environment, Natural Systems, and Development at 73-115 (cited in note 4); Ortolano, Environmental Planning at 25-34 (cited in note 4); Lowe, Lewis & Atkins, Total Environmental Control at 3 (cited in note 4).

26. The Netherlands and Sweden have adopted variations of such a strategic approach. Frances Irwin, Overview, in Haigh & Irwin, eds, Integrated Pollution Control at 26 (cited in note 2). In the Netherlands, activities or "target groups" that have common pollution problems are selected on the basis of their impact on environmental pollution and the national economy. Agriculture, electric utilities, refineries, and traffic are among the target groups identified. The activity of a target group is described in a report that discusses the processes, controls, technical possibilities, and costs of improving pollution control. The appointed coordinator is consulted on the content, pace, and order of potential control measures. He or she is thus able to offer an overview of the problem and the possible remedies. Sweden adopts percentages as objectives of pollution reductions in target groups and allocates funding to achieve such cuts. Frances Irwin, Introduction to Integrated Pollution Control, in Haigh & Irwin, eds, Integrated Pollution Control at 3-30 (cited in note 2).

27. James M. Utterbach, Innovation and Industrial Evolution in Manufacturing Industries, in Bruce R. Guile & Harvey Brooks, eds, Technology and Global Industry: Companies and Nations in the World Economy 17 (Natl Acad Press, 1987). A corollary of this union of product and process is that key productive units can be arranged in a dependent hierarchy from final market demand to equipment and material suppliers. Thus, what is viewed as a product innovation by a unit at one level, is part of the production process or production of a unit at the next higher level.

28. See Ackerman & Hassler, 89 Yale L J at 1483-84 (cited in note 6).
of SO₂ generated that have been achieved by simple and cheap washing techniques used on high-sulphur coal, prior to its use in production, varied from 20 percent to 40 percent, compared to less than 50 percent gained from employing billion-dollar scrubbers. Similarly, the burning of high quality natural gas releases even fewer harmful residuals.29

Apart from considering inputs, an integrated approach, unlike a fragmented one, generally includes the end product as a factor when dealing with harmful residuals. The distinctive nature of the final product has considerable influence on the residuals discharged. For example, the production of a highly bright, bleached white paper, as compared to unbleached paper,30 requires substantially greater quantities of chemicals, water, and energy, resulting in the generation of larger amounts of residuals.31 One study found that the liquid residuals were reduced by 85 to 90 percent by not bleaching, and gaseous residuals were reduced by 50 percent.32

The same argument applies to a wide variety of end products. A failure to determine, ex ante, the need for, or desirability of end products ignores the environmental costs of the bewildering array of often unnecessary goods paraded on the market. Moreover, where the end product is a chemical substance, such as cadmium, an integrated approach can evaluate how it enters more than one medium at the source, moves across media boundaries, and reaches the receptor through more than one medium. The substance in question could be banned or controlled on the basis of the risk it poses.

Finally, integrated policies lead to good management because they focus attention on how changes in production processes can reduce pollution. For example, in order to comply with air, water, and waste laws, U.S. power plants resorted to increasing numbers of technological fixes such as cooling towers, scrubbers, and electrostatic precipitators. The resulting pollution control equipment can amount to 45 percent of the capital cost and 30 percent of the operating cost of a coal-fired plant. Pilot projects indicate that integrating controls into the design of the plant could cut these costs by as much as one-half.33 The experience of the United Kingdom emphasizes the importance of addressing pollution control decisions at the stage of plant design, when appropriate designs can yield substantial reductions in operating costs.34

32. Id at 64-75.
34. Irwin, Introduction to Integrated Pollution Control at 19 (cited in note 26).

Two case studies undertaken by the Pollution Inspectorate in the United Kingdom emphasize the importance of addressing pollution control decisions at the stage of plant design. The report on the case studies note that involvement at the design stage may be required in order to carry out its mandate of IPC. Id at 19-20.
The new amendments to the Clean Air Act, dealing with emission standards applicable to hazardous chemicals, give the EPA administrator power to require the application of a variety of measures, processes, methods, systems, or techniques. These include the substitution of materials, the reduction or elimination of pollutants through process changes, including changes in design, equipment, and training. It seems that such provisions open the door to IPC, particularly as the administrator is specifically required to consider non-air quality health and environmental impacts of air pollution standards.

IV

THE DIFFICULTIES IN IMPLEMENTING AN INTEGRATED APPROACH

The case for adopting an integrated approach to pollution control will be significantly weakened unless we surmount certain difficulties. Socio-political difficulties surround the meaning of integration and socio-scientific difficulties beset the application of the concept. The socio-political uncertainties surrounding the meaning and nature of an integrated program are considerable. The types of IPC schemes range over a confusing spectrum. At its broadest strategic level, IPC can include grand or macro policymaking that addresses pollution caused by national and even international energy, agricultural, and industrial policies. This broad type of pollution control can also intervene within markets to restrict or disallow preferences for certain products.

At the opposite end of the spectrum, a narrow and strictly operational view of IPC confines it to matters within the factory fence. Such a view restricts IPC to the management of residuals or the waste stream in order to secure an optimal distribution of waste among different media. Changing policies responsible for the waste, interfering with demand for products, or substituting inputs that produce less waste fall outside the province of this narrow type of integrated approach.

In the middle, another type of integrated pollution control attempts to deal with broader issues, such as the choice of disposal sites, in order to take advantage of the environmental capacities of differing locations. From this standpoint, IPC focuses on technologies and processes that minimize undesirable residuals, disposal methods that take account of cross-media effects, and the optimal distribution of waste.

To illustrate the nature of the socio-political difficulties concerning the scope and meaning of IPC, suppose that a plant has a coal-burning electric generator that discharges unacceptable levels of sulphur dioxide. Management proposes to install flue gas desulphurization to deal with this problem. One of the desulphurization technologies considered is the application of pulverized limestone, which results in the creation of gypsum-
rich sludge. Large quantities of such waste are expected. What type of integrated pollution control could be applied in this situation?

At the narrow and strictly operational level, an integrated approach would accept and plan for such residuals or wastes, and seek to find the optimal balance for disposing of the pollutants into the air, land, or water through the use, for example, of a coordinated permit. A second, more far-ranging type of IPC would evaluate the underlying decision to undertake flue gas desulphurization within a broader context. Such an inquiry could involve investigating the environmental effects of limestone quarrying. This approach could also consider the effect quarrying has on the area from which limestone is removed, particularly if it is found in a national park or an area of outstanding natural beauty. Furthermore, this approach would ask what the effects are of transporting limestone across unspoiled countryside, and what the environmental consequences are of having to store limestone in large quantities. Finally, the broader approach would examine the environmental impact of disposing of the sludge created by this particular technology. Having assessed the environmental impact of the proposed changes, this version of IPC would consider whether a case could be made for a different method of desulphurization based on an alternative technology.

Advocates of a third and even broader type of IPC would argue that it is necessary to go further and consider the socio-economic question of the acceptability of coal-fired generators. In order to answer this question, coal-burning electricity generation would be balanced against alternative sources of energy such as nuclear, solar, wind, geothermal and hydroelectric power, and fuel cells. Proponents of this more comprehensive approach could also inquire whether generators are necessary at all when better energy conservation and energy efficiency could decrease the need for electric energy. 37

This broad strategic approach could be extended even further. Most human activities result in the creation of residuals or wastes; therefore, most social and economic activities have environmental and ecological repercussions. Because of this, anything less than an integrated environmental resource strategy that comprehensively plans and completely integrates environmental factors into decisionmaking could be seen as inadequate. 38 It is crucial, then, that the integrated approach be defined

37. This was the argument in Vermont Yankee Nuclear Power Corp. v. Natural Resources Defense Council, Inc., 435 US 519 (1978). The arguments for energy efficiency and alternative sources of energy are forcefully employed by those proposing a cut in the emission of carbon dioxide in order to avert global warming. See, for example, S 324, 101st Cong, 1st Sess (1989), and HR 1078, 101st Cong, 1st Sess (1989).

clearly so as to overcome the socio-political uncertainty, and the ensuing controversy, surrounding its meaning.

Socio-scientific difficulties compound the socio-political ones. Evaluating the impact of a waste stream can be a daunting task. To begin with, ascertaining the impact of a pollutant on receptors—whether humans, fauna, or flora—is an exceptionally difficult undertaking. The control of toxic chemicals illustrates the problem. We live in a world where chemicals play an inevitably important part. In the United States, about 250,000 new chemicals are produced annually, of which about 1,000 find their way into the commercial market place.39 The population of the United States is exposed to about 60,000 to 70,000 chemicals40 out of a mind-boggling universe of five million known chemicals.41 A National Research Council panel concluded that toxicity studies have not been done on the majority of the tens of thousands of chemicals now in industrial use in the United States.42

Ascertaining the synergistic effects of all these chemicals is a baffling task. There is very little knowledge about how frequent or strong synergistic or blocking effects might be. There is an equal paucity of knowledge of the combinations of substances and activities that are likely to give rise to adverse synergistic effects.43 Also, there is little data about a pollutant’s transport and fate once it enters the environment. Information about the transfer, degradation, accumulation, and interaction of a chemical with other pollutants is sparse.44 These difficulties are multiplied by the fact that many hazards produce their effects by exposure over time.45 It is not known what the effects of incremental exposure to many hazards are, or which rates of exposure carry the greatest risk.46 Finally, there are a cluster of difficulties the destruction of critical ecosystems, cannot continue unabated. It argues that further development and progress will depend on how society faces up to the frightening fact that natural resources and ecological processes that support and sustain human communities and the environment are being appropriated for consumption while at the same time being damaged by pollution resulting from the burden of residuals. Any satisfactory answer to these problems can be found only within the parameters of a strategy that seeks (1) to manage and conserve natural resources to extend and prolong their life cycles; (2) to preserve ecosystems and genetic diversity; and (3) to minimize the impact of pollutants and wastes. The WCS reasons that all of these undertakings should form part of an integrated strategy.

42. Id.
43. National Research Council (U.S.), Improving Risk Communication at 43 (cited in note 21).
44. Conservation Foundation, Controlling Cross-Media Pollutants at 27 (cited in note 2); National Research Council (U.S.), Improving Risk Communication at 40-41 (cited in note 21). Thus, the hazardous substance released at the source may be different in quantity and kind from those to which people are ultimately exposed. Measurement of exposure, for the purpose of determining effects on human health are, therefore, best determined at the places where people live and work. Such an exercise can be very expensive.
45. Exposure to radiation, for example, will have different effects depending on whether it occurs at once, is spread over several smaller exposures, or is continuous at a low rate over a long period of time. National Research Council (U.S.), Improving Risk Communication at 41 (cited in note 21).
46. National Research Council (U.S.), Toxicity Testing at 60 (cited in note 41).
surrounding the uncertainties of the risk assessments and the problem of finding common measurement of risk that is necessary to embark on a program of integrated pollution control.

V
The Next Steps

Despite these difficulties, it is possible to take immediate steps toward implementing IPC. First, it is important to remember that the difficulties encountered in the United States are not peculiar to this country. They are being experienced by most industrial countries. The common domain of environmental problems, therefore, calls for a comparative approach to environmental problems. In fact, the unique commonality and universality of environmental problems renders the need for comparing indigenous solutions with those of other countries almost inescapable. In searching for ways to overcome our difficulties, we can learn from the experience of European countries. One lesson that European experiences with integrated pollution control teach is the need to strengthen the unified character of EPA. Integrating EPA may be a more realistic goal than ever before, since the administrator, William Reilly, and assistant administrator, Terry Davis, are the nation's foremost proponents of integrated pollution control. Moreover, provisions of law such as section 112(d)(2) of the Clean Air Act, as amended in 1990, enable the administrative application of IPC.

Second, environmental impact assessment should be applied by EPA to its own actions. Unfortunately, from early in its history, EPA has insisted that the National Environmental Policy Act ("NEPA") did not apply to its own regulatory activities. In several cases in which the issue was raised, EPA persisted in claiming that it was not bound by the provisions of NEPA and sought to justify its position on broad policy grounds. The policy argument was based on the nature of the objectives and deadlines embodied in the statutes that EPA administers, especially the Clean Air and Clean Water Acts. These statutes require rapid and expeditious action, which would be delayed by the time involved in complying with NEPA procedures. Further, EPA argued that both acts preclude consideration of the environment as a whole.

47. The problem-oriented approach to comparative law is well established. See, for example, John B. Howard, International Legal Studies, 26 U Chi L Rev 577, 583-85 (1959); Konrad Zweigert & Hein Kötz, Introduction to Comparative Law 1-27 (Clarendon Press, 1987).


49. Appalachian Power Co. v EPA, 477 F2d 615 (4th Cir 1973); Buckeye Power Inc. v EPA, 481 F2d 162 (6th Cir 1973); Duquesne Light Co. v EPA, 481 F2d 1 (3d Cir 1973); Essex Chemical Corp v Ruckelshaus, 486 F2d 427 (DC Cir 1973); Portland Cement Ass'n v Ruckelshaus, 486 F2d 375 (DC Cir 1973); Anaconda Co. v Ruckelshaus, 352 F Supp 697 (D Colo 1972), rev'd, 482 F2d 1301 (10th Cir 1973); Getty Oil Co. v Ruckelshaus, 342 F Supp 1006 (D Del 1972), aff'd, 467 F2d 3449 (3d Cir 1972); Envtl Def Fund v EPA, 489 F2d 1247 (DC Cir 1973); Wyoming v Hathaway, 525 F2d 66 (10th Cir 1975); Maryland v Train, 415 F Supp 116 (D Md 1976).
and, by implication, stand in the way of an integrated approach to pollution control.\textsuperscript{50}

Moreover, EPA determined that regulations under the Resource Conservation and Recovery Act of 1976, the Toxic Substances Control Act of 1976, the Safe Drinking Water Act, and the Noise Control Act are exempt from NEPA.\textsuperscript{51} Although EPA's views prevailed in court, the opportunities for requiring the agency to produce environmental impact assessments, or their functional equivalents, have not altogether been closed. In fact, a promising opportunity for using the environmental impact statement was created by one of the cases that EPA won, \textit{Portland Cement Association v. Ruckelshaus}.\textsuperscript{52} \textit{Portland Cement} held that EPA was not required to undertake environmental assessments under NEPA because it had to engage in the functional equivalent of an impact assessment when setting standards for new sources under section 111 of the Clean Air Act.\textsuperscript{53} In making this decision, the D.C. circuit opened the door to similar interpretations not only for other provisions of the Clean Air Act, but for all acts administered by EPA. \textit{Portland Cement} was a significant factor leading EPA to what has been described as the "giant practical step"\textsuperscript{54} of issuing a policy statement indicating that it would voluntarily prepare environmental impact statements in connection with certain major regulatory activities.\textsuperscript{55} If that be the case, EPA should in the future confront the wider environmental impacts of pollution regulation, and it is difficult to see how EPA can avoid recognizing both the wisdom and the

\textsuperscript{50} After one case effectively held that EPA was bound by the NEPA, Congress intervened to nullify the impact of that decision. \textit{Kalur v Resor}, 335 F Supp 1 (D DC 1971), went against the tide and held that the Army Corps of Engineers was fully subject to the NEPA in exercising its powers under the Refuse Act Permit Program, and could not delegate its statutory authority under the Refuse Act to EPA. Id at 14-15. Congress responded by exempting EPA from that responsibility. The Clean Water Act exempts EPA from preparing impact statements to accompany its actions except when dealing with grants to municipalities for waste treatment facilities and permits for discharges from new sources. Clean Water Act § 511(c)(1), 33 USC § 1371(c)(1) (1982). Similarly, the Energy Supply and Environmental Coordination Act of 1974 provided that no action taken by EPA under the Clean Air Act would require an environmental impact statement. Energy Supply and Environmental Coordination Act of 1974, § 7(c)(1), 15 USC § 793(c)(1) (1982).

\textsuperscript{51} 44 Fed Reg 64,174 (1979).

\textsuperscript{52} 486 F2d 375 (DC Cir 1973). This case dealt with new source performance standards. The plaintiff industries argued, \textit{inter alia}, that NEPA applied and that EPA should carry out a detailed cost-benefit analysis that evaluated pollution reduction levels against incremental increases in industry expenditure. Comment, \textit{Implementation of the Clean Air Act: Should NEPA Apply to the Environmental Protection Agency?}, 3 Ecol L Q 597, 617 (1973) (authored by Barry S. Neuman) (citing Brief for Portland Cement Ass'n as Petitioner at 25, \textit{Portland Cement Assn v Ruckelshaus}, 486 F2d 375 (DC Cir 1973)). The court decided that it was not necessary to decide the broad question of NEPA's applicability to EPA on the ground that section 111 of the Clean Air Act constituted a narrow exemption from the NEPA. 486 F2d at 384. Judge Leventhal resolved that any determination of the "best system of emission reduction," which took "into account the cost of achieving such reduction," constrained the administrator to consider counter-productive environmental effects as well as the cost to industry. Id at 384, 385. Together with the need for a statement of reasons, these factors constituted the "functional equivalent" of a NEPA impact statement and exempted EPA from stricter requirements of the NEPA. Id at 384.

\textsuperscript{53} 42 USC § 111.


\textsuperscript{55} 38 Fed Reg 16186-87 (1974).
necessity of an integrated pollution control scheme. Whether they be environmental impact statements under NEPA or their functional equivalents, impact assessments are an essential element of IPC.

Third, EPA should adopt a more enlightened approach to risk management, which has emerged as one of EPA’s high priorities. It is important, however, that risk management embrace notions foreign to its original conception, such as public perception, qualitative values, and harm to nature.

Finally, a vigorous implementation of the Toxic Substances Control Act ("TSCA") will offer a promising opening for IPC. TSCA has institutionalized an integrated approach to the control of chemicals. It embraces the entire environment, together with total human exposure, and is not confined to the usual divisions between air, land, and water, or to particular routes of exposure. It focuses on the full cycle of a substance from manufacture through disposal, and provides a viable baseline from which to move toward the administrative implementation of an integrated approach.

56. In a promising development, a recently proposed bill to set up a Global Environmental Research and Policy Act requires federal agencies to ensure that they consider the effects of their actions, including extraterritorial effects on other countries and the global community. HR Rep No 3332, 101st Cong, 1st Sess at 17 (1990).


58. For a fuller discussion, see Guruswamy, 7 Ariz J Intl & Comp L at 204-15 (cited in note *).

59. The term "environment" is defined to include "water, air, land and the interrelationship which exists among and between water, air and land and all living things." Toxic Substances Control Act § 3(5), 15 USC § 2602(5) (1982).

60. This conclusion is borne out by its history. For a fuller discussion, see Guruswamy, 1989 Wis L Rev at 523-25 (cited in note *). In 1971, President Nixon submitted a bill to Congress, The Toxic Substances Act, which sought to integrate the way in which toxic substances were controlled. 15 USC §§ 2619 et seq (1976). The Council on Environmental Quality, which had researched and drafted the bill, set out its reasoning and conclusions in an influential report on toxic substances. Council on Environmental Quality, Toxic Substances (U.S. Govt Printing Office, 1971). It argued that most toxic substances are not exclusively air or water pollutants, but are found in varying quantities in air, water, soil, food, and industrial and consumer products. The multiplicity of ways by which society is exposed to toxics makes it difficult for the media-oriented authorities to consider the total exposure of an individual to a given substance, a consideration necessary for the establishment of adequate environmental standards. In terms of human health, total exposure of a human being to a given substance from all parts of his environment, air, water and food must be considered, and the interaction of these substances, both within and outside the body, must be evaluated. Similar consideration must be given to other living organisms. Since no agency had considered itself completely responsible for all such substances in all media, the CEQ recommended that a new legal authority, EPA, should take over that function. Id at v-vi (emphasis supplied).

The Toxic Substances Control Act was passed in 1976. It had a troubled history marked by disagreements between the House and Senate. See House Committee on Interstate and Foreign Commerce, Legislative History of the Toxic Substances Control Act 409 (Comm Print, 1976); Ray M. Druley & Girard L. Ordway, The Toxic Substances Control Act 9-26 (Bureau Natl Aff, 1981); Kevin Gaynor, The Toxic Substances Control Act: A Regulatory Morass, 30 Vand L Rev 1149-52 (1977); Roger W. Findley & Daniel A. Farber, Environmental Law 445 (West, 2d ed 1985). See also HR Rep No 1341, 94th Cong, 2d Sess at 7-8 (1976); Joint Explanatory Statement of the Committee of Conference at 668 (1976). It is important for our purposes that the disagreement between the House and Senate did not turn on the need for or relevance of integration.
VI

CONCLUSION

The environment could be compared to an immensely intricate, fragile, and sensitive mobile. To the extent everything is inter-connected, a touch at one point could send tremors through other parts. Ideally, then, action affecting the environment should be taken only after a comprehensive evaluation and full understanding of all the complexities and variables. There are numerous obstacles, however, that can frustrate a decisionmaker attempting to adhere to the tenets of such a comprehensively rational model.

According to Charles Lindblom, it is precisely because everything is inter-connected that environmental problems elude comprehensive analysis. The problems are so complicated as to lie beyond our capacity to control them through one unified policy. Instead, according to Lindblom, critical points of intervention must be found; a pragmatic step-by-step or incremental approach to policymaking will solve problems more effectively than an idealistic “holistic” model incapable of practical application.

There is little doubt that the incremental model of “muddling through” has prevailed over an integrated approach. It was natural, perhaps necessary, to begin with an incremental action that responded to the immediate difficulties. Stringent, though fragmented, bodies of legislation dealing with air, water, and land now seek to address the widespread problems of pollution. Although this body of legislation has resulted in impressive gains, the goals of healthy air and swimmable, fishable waters envisioned by such legislation have not been achieved, while the costs of pollution control have escalated.


64. For a fuller consideration of the factors leading to a fragmented approach to pollution control, see Guruswamy, 1989 Wis L Rev at 476-92 (cited in note *).


These deficiencies have caused a re-examination of the character of an integrated approach and led to the forging of a strong case for its adoption.67 A mottled picture emerges from the chrysalis of experience. Although IPC may not be a modern highway, the road is clearly open. The inevitable pioneering difficulties should not thwart the decision to travel the road of IPC, or to open up a new frontier that redefines and reportrays the arc of pollution control.

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