Chapter 4

Common Policy Challenges

Risk Assessment and Environmental Justice

> *While EPA officials said they expect to reduce the uncertainties associated with the health benefit estimates in the final particulate matter analysis, a robust uncertainty analysis of the remaining uncertainties will nonetheless be important for decision-makers and the public.*
>
> —U.S. GAO, 2006[1]

> *Risk assessment means never having to say you're certain.*
>
> —Humor among professional risk assessors

Until 1998, few Americans knew about phthalates or cared about them. In November 1998, however, the environmental organization Greenpeace International released the first of its many reports demanding that the toy industry worldwide immediately abandon the use of the chemical DINP, an ingredient in vinyl, a material widely used throughout the industry in producing thousands of children's products as varied as pacifiers, rubber ducks, teddy bears, dolls, rattles, and teething rings. The report was another sortie in a militant campaign by environmentalists and public health officials against a large class of chemicals called phthalates or plasticizers, which bond with vinyl molecules to make plastic products more flexible. In the United States, the announcement unleashed a relentless public controversy that has continued for more than twenty years, a conflict that quickly assumed a pattern common to the contemporary politics of environmental risk assessment.

A Toxic Nightmare From Toyland?

First came a dramatic public condemnation of an important industrial chemical. Greenpeace International asserted a major domestic chemical

manufacturer used the chemical DINP to manufacture products that children might chew, such as pacifiers and rattles, even though a similar compound caused liver damage in laboratory rats.[2] The accusation and accompanying information, quickly disseminated worldwide by the media, was alarming not only to the chemical producers and to parents whose children might be exposed to the products but also to the hundreds of manufacturers and consumers of other products using plasticizers—products such as medical equipment, food containers, consumer goods, packaging material, and much more—because plasticizers are a global commodity. Within weeks, two major U.S. medical advocacy groups issued a "health alert" warning that intravenous bags and tubing made of vinyl chloride contained a chemical very similar to DINP that previously had been removed from toy products because of suspected toxicity. A story on the popular ABC news program *20/20* in early 1998 repeated many of the Greenpeace International allegations, thus ensuring a huge domestic audience for the controversy. Within a few weeks, the plasticizer debate was a media event.[3]

Next, an acrimonious, highly technical dispute erupted in the public media, abetted by technical publications and professional spokespeople caught up in the controversy, over the extent of the health risks resulting from exposure to the plasticizers. At the same time, the controversy was quickly politicized. Organized groups representing environmentalists, consumers, public health interests, the chemical and toy manufacturers, governmental agencies, parents, political think tanks, and many others rapidly aligned on sides of the issue. Conflict approached the surreal, as exquisitely technical and publicly confounding arguments raged over baby bottle nipples, animal fetuses, Teletubbies, squeeze toys, liver biopsies, monkey testicles, and other exotica. Even Barbie and a former U.S. surgeon general appeared. At stake were possibly a billion dollars in worldwide product sales, the ethical and economic stature of the chlorine chemical industry, markets for hundreds of manufacturers using the embattled chemicals, and perhaps the health of uncounted children worldwide.

The Political Front

Within a week of the Greenpeace International announcement, twelve consumer, environmental, and religious groups demanded that the U.S. Consumer Product Safety Commission (CPSC), the federal regulatory agency responsible for ensuring the safety of children's products sold in the United States, ban vinyl toys for small children. Shortly thereafter, twenty-eight members of Congress addressed President Bill Clinton

through a letter urging him to ensure that the Department of Commerce was not pressuring European countries to keep their markets open to children's vinyl products. The National Environmental Trust, a coalition of environmental organizations, urged the U.S. government to ban all vinyl baby products. In November 1998, the CPSC also stated that it was uncertain about the risks to babies from DINP but nonetheless advised parents to throw away nipples and pacifiers made with vinyl and asked manufacturers not to use DINP in products children might put in their mouths.

Meanwhile, the manufacturer of DINP and many industrial consumers were rising to DINP's defense. Major toy manufacturers, such as Mattel; large toy retailers, including Toys R Us; and the industry's trade association, the Toy Manufacturers of America, all publicly defended the safety of the plasticizers used for decades in children's products. Defenders of DINP were enormously gratified when a nonprofit organization of distinguished scientific experts asserted that it stood "firmly behind the conclusions drawn from the weight of the scientific evidence [that] consumers can be confident that vinyl medical devices and toys are safe."[4]

A Scientific Enigma

The actual risk to children from exposure to plasticizers seemed anything but clear. One problem was the absence of a standard procedure to determine how much of the suspect chemical a child could realistically be expected to absorb. In addition, toy components vary considerably in their plasticizer content. For instance, high levels of DINP were found in the arms of the Rugrats Tommy Pickles Ice Cream Face doll and in the shoes of the Cabbage Patch Kids Star Rosie doll but not elsewhere on either doll.

Another major problem involved the reliability of the animal tests indicating that DINP and its predecessor could cause liver damage in humans. Critics of these tests noted that similar damage did not occur in other experimental animals, including guinea pigs, hamsters, and monkeys. Also the age of the test animals might matter. Other disagreements arose over the relative importance to be given to toxic effects observed in different organs of experimental animals.[5]

Finally, there was the unsettling enigma about how long it could take before any health problems might appear among children exposed to plasticizers. Health professionals noted that the damaging effects of such exposure might be latent for many years and that, as a consequence, the current incidence of any suspected damage might greatly underestimate the long-term damage to humans. Thus, it might seem prudent to ban the plasticizers even in the absence of convincing, current evidence of their danger.

Barbie Gets a Green Makeover

With the controversy public, the Toy Manufacturers of America reluctantly advised its members to voluntarily eliminate DINP-based vinyl products even while it maintained their safety.[6] The Chlorine Chemistry Council, representing the users of all chlorine-based products, and toy manufacturers continued to defend DINP. The industry's capitulation was ensured when Mattel, the world's largest toy manufacturer, announced in December 1999 that it would substitute plant- and vegetable-based plastics for chlorine-based vinyls. Barbie was destined for a complete chemical makeover, along with a multitude of other familiar toys and products from other manufacturers, among them Teletubbies, Pony Luv, and Clear and Soft pacifiers and nipples.

In 2003, to the considerable satisfaction of the Chlorine Chemistry Council and toy manufacturers, the CPSC voted unanimously to deny the petition to ban phthalates from products for children younger than five years old, because there appeared to be "no demonstrable health risk."[7] The CPSC also knew how to defend itself. This decision, it noted, was supported by numerous scientific studies including a meticulous inquiry concerning "mouthing habits" among infants. The "average daily mouthing time" of soft plastic toys for children twelve to twenty months of age was 1.9 minutes, considerably fewer than the seventy-five minutes per day determined to be the risk threshold.[8] Average daily mouthing time, however, was not the science that satisfied most public health and environmental advocates, who continued to advocate the elimination of phthalates from toys.

And the Winner Is . . .

By 2006, phthalate opponents had rearmed with a new wave of highly publicized scientific studies once again implying that phthalates might be a human toxic. One university study suggested that mothers exposed during pregnancy to high levels of phthalates found in cosmetics, plastics, and detergents might have "less masculine" boys; another investigation noted that plastic food containers might "contribute" to breast cancer.[9] The Cosmetic, Toiletry and Fragrance Association protested that "an extensive body of science research"[10] proved the safety of cosmetics, but public health and environmental advocates persisted, determined to skewer high-profile industries, such as nail polish manufacturers, with apparently damning scientific research.

Public health and environmental organizations also exploited opportunities to pressure the federal government from other political venues. As early as 2002, the California legislature passed legislation prohibiting

baby toys containing phthalates. In December 2006, San Francisco became the first U.S. city to prohibit the sale, manufacture, and distribution of products with high phthalate concentrations.[11] A powerful political blow against phthalates was struck by the European Union (EU), which in late 2006 passed a law regulating the manufacture and use of thirty thousand toxic substances, including phthalates, thus creating enormous pressure on U.S. industry to do the same.

By 2010, continuing scientific evidence raised such substantial doubt about phthalate safety that parents and other consumers of phthalate-containing products were no longer left to decide which side—if any—should be trusted. A 2008 report of the National Academy of Sciences voiced considerable concern about phthalate safety and urged Congress and the EPA to promote new studies about the effects of cumulative human exposure to all phthalates.[12] This report, fortified by other accumulating research, created a receptive setting for new regulatory legislation. In September 2008, Congress passed the Consumer Product Safety Reform Act (CPSRA) mandating, among other important provisions, that the CPSC prohibit DINP and certain other phthalates in children's toys and care products and require manufacturers of children's products to test their safety and certify it.

The American Chemistry Council, a major organizational voice of the chemical industry, predictably expressed the industry's dissatisfaction with the CPSRA, arguing that "after all this study and review, no reliable scientific evidence has found phthalates to cause adverse human health effects."[13] In mid-2012, the plasticizer controversy revived on yet another front when the Food and Drug Administration (FDA), the federal agency responsible for assuring the safety of ingredients in domestic food products, proposed to ban another plasticizer, bisphenol A (BPA) from infant-feeding products, such as children's sippy cups and baby bottles. However, the FDA also stated that adult food containers could safely contain BPA. Public health groups were not satisfied. By 2013, the phthalate conflict had spread across a regulatory battlefront embracing a multitude of other phthalates. The CPSC, confronting a swelling volume of risk assessment studies by phthalate critics, was compelled to parse out of the data further decisions concerning additional phthalates to regulate, in what children's products, and what exposure levels to prohibit.

In December 2014, the CPSC proposed a new "phthalate rule" that vastly enlarged the scope of federal phthalate regulation. The rule prohibited the phthalate DINP in all children's toys, not only those which could be placed in the mouth, expanded the list of phthalates permanently banned from child care products, and ratcheted down the level of phthalates permitted in specified children's products.[14] But the CPSC's

proposed new rule assured further phthalate controversy, because it removed several plasticizers from existing regulation and failed to extend regulation to other children's products, such as rainwear, footwear, backpacks, and some school supplies known to contain plasticizers regulated in children's "mouthing" products. However, the new, improved, rubber duck and other children's toys free of banned phthalates will contain substitute plasticizers that may incite additional public health controversy.

The continuing phthalate investigations will likely eliminate more plasticizers from infant and children's products and perhaps from adult materials as well. In a broader perspective, the conflict also introduces the policymaking pathway that is common to most risk assessments required by federal law and the focus of this chapter—a path littered with protracted litigation, sustained political infighting, disputed science, and multiple government venues.

Risk Assessment and the Limits of Science

In recent years, the EPA alone has written more than 7,500 risk assessments annually in various forms to carry out its regulatory responsibilities.[15] In 1993, President Clinton further elevated the importance of risk assessment by requiring in Executive Order 12866 that all regulatory agencies, not only environmental ones, "consider, to the extent reasonable, the degree and nature of risks posed by various substances or activities within its jurisdiction" and mandating that each proposed regulatory action explain how the action will reduce risks "as well as how the magnitude of risk addressed by the action relates to other risks within the jurisdiction of the agency."[16]

Traditional risk assessment associated with environmental regulation creates a flow of decisions that starts, as Figure 4.1 indicates, when the EPA or another regulatory agency is required to determine whether a substance—a commercial chemical, for example—constitutes a sufficient hazard to humans or to the environment to require regulation under one of many current environmental regulatory laws. The process begins with research that assembles currently available information about the possible adverse health or environmental effects of a suspected hazard, such as a chemical. If the research suggests possibly adverse effects to humans or the environment, the regulatory agency proceeds to risk assessment, during which additional information is obtained or experiments are conducted concerning the current levels of exposure to a suspected chemical, and an estimate is made of the likely adverse consequences. If this risk assessment indicates that a chemical is sufficiently hazardous to meet the requirements for regulation, the agency proceeds to risk management,

during which regulators consider alternative strategies for the chemical's regulation and then propose a regulatory plan. Figure 4.1 may imply a dependably neat, deliberate, and timely sequence of decisions, but the reality is often many decisions contested and elapsed time in years or decades.

Risk assessment has grown increasingly controversial, until it now incites the impassioned conflicts once confined to holy wars, such as the benefit–cost debate. A major reason for the controversy is that risk assessment lies in the treacherous zone between science and politics, where practically all environmental policies reside and where collaboration between public officials and scientists is both essential and difficult. What public officials and scientists involved in policymaking want from each other is often unobtainable. Public officials seek from scientists information that is accurate enough to indicate precisely where they should establish environmental standards and credible enough to defend in the inevitable conflicts to follow. Scientists want government to act quickly and forcefully on ecological issues they believe to be critical.[17] Yet science often cannot produce technical information in the form and within the time desired by public officials. Indeed, science often cannot provide the information at all, leaving officials to make crucial decisions from fragmentary and disputable information.

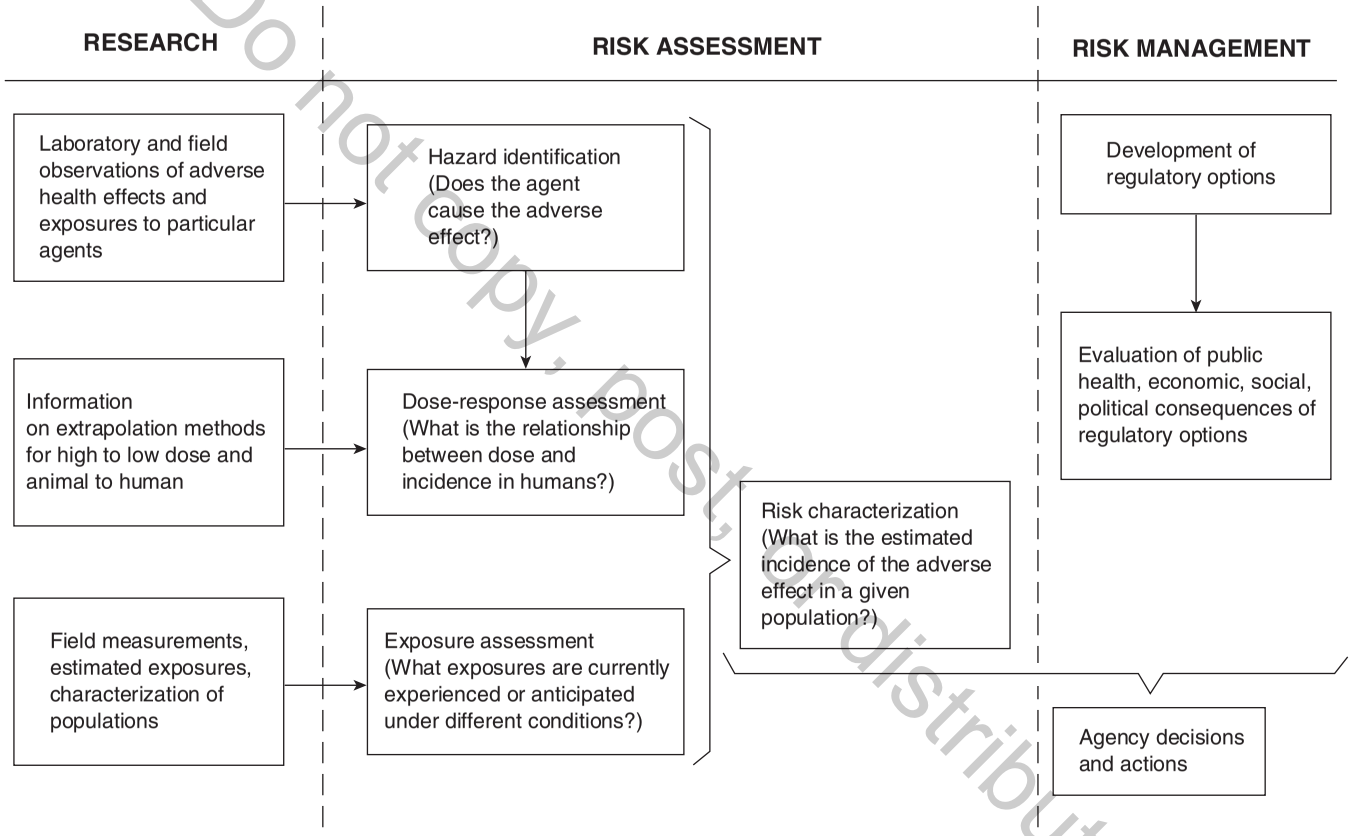
In short, risk assessment frequently compels public officials to make scientific judgments and scientists to resolve policy issues for which neither may be trained. The almost inevitable need to resolve scientific questions through the political process and the problems that arise in making scientific and political judgments compatible are two of the most troublesome characteristics of environmental politics.

Derelict Data and Embattled Expertise

Controversy among experts commonly arises in environmental policymaking. Contending battalions of experts, garlanded with degrees and publications and primed to dispute each other's judgment, populate congressional and administrative hearings about risk assessment. Policymakers are often left to judge not only the wisdom of policies but also the quality of the science supporting the policies.

Missing Data. Why is controversy so predictable? Frequently there is a void of useful data about the distribution and severity of environmental problems or possible pollutants. Many problems are so recent that public and private agencies have only just begun to study them. Many pollutants—hazardous chemicals, for instance—have existed for only a few decades; their ecological impacts cannot yet be measured reliably.

Figure 4.1 The Risk Assessment Process



Source: National Research Council, *Risk Assessment in the Federal Government: Managing the Process* (Washington, DC: National Academy Press, 1983), 21. Reprinted with permission from National Research Council. Courtesy of the National Academies Press, Washington, DC.

The EPA alone receives about 1,500 petitions annually requesting the approval of new chemicals or new uses of existing chemicals for which tests may be required.[18] Quite often the result is that nobody has the information that somebody should have. For instance, the EPA and the U.S. Department of Health and Human Services together have data reporting the degree of exposure among the general population for less than 7 percent of more than 1,400 chemicals considered to pose a threat to human health.[19] Lacking high-quality data, experts often extrapolate answers from fragmentary information, and plausible disputes over the reliability of such procedures are inevitable.

Late and Latent Effects. Disagreement over the severity of environmental problems also arises because the effects of many substances thought to be hazardous to humans or the environment may not become evident for decades or generations. The latency and diffusion of these impacts also may make it difficult to establish causality between the suspected substances or events and the consequences. Asbestos, a hazardous chemical whose malignancy has been documented since 1979, illustrates these problems.[20] Since World War II, approximately eight million to eleven million U.S. workers have been exposed to asbestos, a mineral fiber with more than two thousand uses; its heat resistance, electrical properties, immunity to chemical deterioration, and other characteristics made it appear to be ideal to a multitude of major industries. In the past, it was used widely to manufacture brake and clutch linings, plastics, plumbing, roofing tile, wall insulation, paint, paper, and much else. Asbestos is highly carcinogenic. Among those exposed to significant levels of asbestos, 20 to 25 percent died of lung cancer, 7 to 10 percent perished from mesothelioma (cancer of the chest lining or stomach), and another 8 to 9 percent died from gastrointestinal cancer.[21] The toxicity of asbestos became apparent only decades after workers were exposed, because the cancers associated with it do not become clinically evident until fifteen to forty years after exposure, and severe illness may appear two to fifty years after the cancers first appear in humans. Added to the incalculable cost of human suffering is the immense economic impact of these delayed effects. More than two thousand new cases of incurable asbestos-related cancer now appear each year in the United States. Presently, three hundred thousand lawsuits arising from human exposure to asbestos are pending in the nation's courts, and twenty thousand to fifty thousand lawsuits are predicted annually for several decades. U.S. corporations and insurers have spent more than $30 billion to defend and settle asbestos lawsuits. The total cost of these suits, according to several professional estimates, may exceed $200 billion.[22]

Many other substances used in U.S. commerce, science, and domestic life are suspected of producing adverse impacts on humans or the environment. Yet conclusive evidence might not appear for decades, whereas government officials must decide whether to regulate these substances now. Difficult as such decisions are, a failure to act, as in the case of asbestos, eventually may prove so costly in human suffering and economic loss that many scientists may be reluctant to wait for conclusive data, even though others may argue the evidence is inconclusive. These issues are illustrated vividly by the federal government's continuing problems with the chemical dioxin.

The Case of Dioxin. Early in the 1990s, the EPA was persuaded by growing scientific evidence to initiate a searching reevaluation of its twenty-year-old exposure standards for the chemical dioxin, which it had characterized earlier as one of the most lethal substances on Earth.[23] The most dangerous among the seventy-five varieties of dioxin was thought to be 2,3,7,8-tetrachlorodibenzodioxin (TCCD), considered so harmful that the EPA's maximum exposure standards had limited human ingestion of TCCD to 0.006 trillionth of a gram per day for every kilogram (2.2 pounds) of body weight over an average lifetime—in other words, an average-size man was limited daily to an amount equal to a grain of sand sliced one billion times.

The EPA's original exposure standard for dioxin, as with most risk assessments made by federal agencies, was extrapolated largely from animal experiments. In the late 1970s, the EPA ordered an end to the production of the weed killer 2,4,5-T, also a dioxin, on the basis of its own earlier studies and additional, if circumstantial, evidence of great harm to individuals exposed to high concentrations of the herbicide. When concentrations of dioxin far exceeding levels considered safe were discovered during 1981 in the soil of Times Beach, Missouri—the result of illegal toxic waste disposals—the EPA decided that public safety required the permanent evacuation of the entire Missouri community. All 2,240 residents were removed to new residences and reimbursed for their property at a cost exceeding $37 million, while an additional $100 million was spent to clean up other nearby contaminated sites. During the 1980s, hundreds of lawsuits were filed against the federal government by Vietnam War veterans for alleged health impairment from exposure to dioxin in the defoliant Agent Orange. Meanwhile, the EPA's strict standards were expected to cost the paper and pulp industry about $2 billion for pollution control.

But a growing number of scientific experts questioned not only the EPA's exposure standards for dioxin but also the reliability of all the animal studies for determining the safe levels of human exposure to

hazardous substances.[24] A particularly damning public indictment of the EPA's own standard appeared in 1991 when the federal scientist who had ordered the evacuation of Times Beach admitted to a congressional committee that he made the wrong decision. "Given what we know now about this chemical's toxicity," then assistant surgeon general Vernon N. Houk stated, "it looks as if the evacuation was unnecessary."[25] Additional complications arose in the 1990s. A panel of experts convened by the EPA concluded that, although dioxin was a significant cancer threat to people only when they were exposed to unusually high levels in chemical factories, it wreaked biological havoc among fish, birds, and other wild animals even in minute doses.[26] Shortly thereafter, the agency supervising all federal animal studies used in toxics regulation released another report suggesting that animal studies alone were not reliable for judging the exposure risks to human beings in toxics research.[27] The Clinton administration and EPA officials were extremely uneasy with the existing exposure standards, and a thorough restudy of the issue was ordered.

In mid-2000, the EPA released the results of its long-awaited restudy. To the surprise of the White House and most EPA officials, the agency for the first time concluded that dioxin TCCD was a "human carcinogen" and that one hundred related chemicals were "likely" human carcinogens. The result was all the more startling because domestic emissions of dioxin had declined by 87 percent since 1984.[28] Some environmental organizations then deduced from the EPA's risk estimates that about one hundred of the 1,400 cancer deaths occurring in the United States daily were attributable to dioxin. The EPA knew full well what to expect, warning its senior officials that, when the report became public, "many stakeholders [will] take dramatic action" and "pressure from other interests" would grow. Predictably, the EPA's decision was assailed from both sides of the controversy. Major chemical producers asserted the EPA was "out of sync" with dioxin regulation in the rest of the world and the report was "counterintuitive to what the facts are." The U.S. Chamber of Commerce suggested the decision wasn't based on "sound science." Greenpeace International, like some other environmental groups, lacerated the EPA for failing to control aggressively the remaining dioxin emissions; "That suggests that [the EPA] can't walk and chew gum at the same time," it sniffed.[29]

Still, the dioxin controversy would not—and still will not—go away. In mid-2003, Congress passed legislation requiring the National Research Council, a part of the National Academy of Sciences, to perform a complete review of the assessment document—a cascade of reviews that environmentalists claimed was a tactic by the George W. Bush administration to stall the implementation of new dioxin regulations indefinitely.[30] In July 2006, the National Academy of Sciences review concluded that the EPA should reassess the risks of dioxin exposure, especially exposure to

very low dioxin doses, and issue a revised risk assessment explaining more clearly "how it selects both the data upon which the reassessment is based and the methods used to analyze them."[31] Meanwhile, the existing EPA risk standards would be enforced. In December 2009, the EPA, in accord with new administrator Lisa Jackson's promise to accelerate its dioxin review, initiated a comprehensive restudy of dioxin health risks. By 2012, the EPA had concluded that "generally, over a person's lifetime, current exposure to dioxins does not pose a significant [non-cancer] health risk," but the EPA had yet to release its highly anticipated assessment of cancer risks associated with dioxin.[32]

Animal and Epidemiological Experiments. Having rejected most controlled human studies as ethically repugnant, scientists are left with no certain alternatives in arriving at risk estimates. The common alternative is controlled animal experiments in which test animals are exposed to substances, the effects are monitored, and the risks to human beings are extrapolated from the findings.

These animal studies are particularly controversial when used to estimate the effects of low levels of chemical exposure on humans—for instance, a dose of a few parts per million or billion of a pesticide or heavy metal in drinking water over thirty years. The human risks of cancer or other serious illnesses will be small, but how small?[33] And, how reliable is the estimate? Animal studies do not and cannot use enough animals to eliminate all possibilities of error in estimating the effects of low-level exposure on humans. To demonstrate conclusively with 95 percent confidence that a certain low-level dose of one substance causes fewer than one case of cancer per million individuals would require a "megamouse" experiment involving six million animals.[34] Instead, researchers use high doses of a substance with relatively few animals and then extrapolate through statistical models the effect on humans from low-level exposure to the tested substance. But these models can differ by a factor of as much as one hundred thousand in estimating the size of the dose that could produce one cancer per million individuals. A litany of other problems is associated with small-animal studies. Failure to observe any response to a substance among a small group of animals does not mean a substance is safe. Moreover, various animals differ greatly in their sensitivity to substances; dioxin is 5,000 times more toxic to guinea pigs than to hamsters, for example.[35]

The Limited Neutrality of Scientific Judgment

Perhaps fifty opportunities exist in a normal risk assessment procedure for scientists to make discretionary judgments. Although scientists are

presumed to bring to this task an expertise untainted by social values to bias their judgments, they are not immune to social prejudice, especially when their expertise is embroiled in a public controversy. According to physicist Harvey Brooks, a veteran of many public controversies,

> The more an issue is in the public eye, the more expert judgments are likely to be influenced unconsciously by pre-existing policy preferences or by supposedly unrelated factors such as media presentations, the opinions of colleagues or friends, or even the emotional overtones of certain words used in the debate.[36]

Scientific judgment on environmental issues can be influenced by one's beliefs about how government should regulate the economy, by one's institutional affiliation, or by other social and political attributes.[37] A study of several hundred risk professionals involved in federal environmental policymaking suggests that, once risk professionals become involved in policymaking, there is "a weakening of disciplinary perspectives and a strengthening of viewpoints based on politics and ideology."[38] Social or political bias can be particularly pernicious when not recognized or admitted by the experts. Yet no barrier can be contrived to wholly insulate science from the contagion of social or economic bias. This is a strong argument for keeping scientific and technical determinations open to examination and challenge by other experts and laypersons.

What Risks Are Acceptable?

Risk assessment for environmental policymaking is also difficult because no clear and consistent definition of *acceptable risk* exists in federal law. *Acceptable risk* is usually defined in environmental regulation by statutory criteria—that is, by standards written into law to guide regulators in determining when to regulate a substance. Despite repeated congressional efforts at clarification, the only consistency in these statutory standards is their inconsistency.[39]

The EPA, uneasy with the enormous scientific uncertainties inherent in determining acceptable risk, frequently has shrouded its discretionary decisions in a fog of verbal mystification. Nonetheless, determining acceptable risk remains an intensely discretionary—and often political—affair, however much the language of the law may try to conceal it.

A Multitude of Risk Criteria

A multitude of different congressional standards guide regulatory agencies in making determinations of acceptable risk. Different substances

often are regulated according to different standards. The same agency may have to use as many as six or seven standards, depending on which substances or which laws are involved. The same substance may be subject to one regulatory standard when dumped into a river and another when mixed into processed food. Statutory risk standards are commonly vague and sometimes confusing; congressional intent may be muddled, often deliberately.

In general, regulatory agencies encounter one or more of the following statutory formulas in determining the permissible exposure levels to various substances.[40] The examples are drawn from existing legislation.

- *Health-based criteria*. Regulatory agencies are to set standards based on risks to human health from exposure to a hazard. These standards are usually "cost oblivious," because they seldom permit agencies to use the cost of regulation as a consideration in standard settings. Health-based criteria, however, can involve different levels of acceptable health risk. The CAA (1970) mandates that national primary ambient air-quality standards "shall be . . . in the judgment of the Administrator, based on [air-quality] criteria and allowing an adequate margin of safety . . . requisite to protect human health." The EPA is also left to determine the magnitude of this "margin of safety" and to whom it applies.[41]
- *Technology-based criteria*. The EPA is instructed to ensure that pollution sources will use the best available or the maximum achievable technology or some other specified technology criteria to control their hazardous emissions. The Safe Drinking Water Act (1974) and the Federal Water Pollution Control Act (1956) use technology-based standards. In effect, acceptable risks are defined by whatever residual risks to public health may exist after the prescribed control technologies are applied to a pollution source.
- *Balancing criteria*. Congress mandates that an agency consider, to varying extents, the costs of regulation or the magnitude of threat to human health alongside the benefits in setting a standard for human or environmental exposure. Or Congress may permit cost considerations to be among other criteria that an agency may consider. These statutes define how various considerations, such as cost and risk, are to be balanced in determining acceptable risk. For instance, a law may permit an agency to balance the benefits for a given regulatory standard (which may include health as well as monetary benefits) against the costs of its enforcement. In contrast, another law may require agencies to balance the benefits against the economic costs in setting standards for exposure to a substance.

Congress often packs regulatory laws with so many criteria for risk determination—lest any important consideration be ignored—that regulatory decisions become enormously complicated. Consider, for instance, the criteria the EPA was ordered to use under TSCA (1976) when deciding whether the risks from exposure to a substance are unreasonable:

> The type of effect (chronic or acute, reversible or irreversible); degree of risk; characteristics and number of humans, plants and animals, or ecosystems, at risk; amount of knowledge about the effects; available or alternative substances and their expected effects; magnitude of the social and economic costs and benefits of possible control actions; and appropriateness and effectiveness of TSCA as the legal instrument for controlling the risk.[42]

Agencies spend considerable time working out detailed internal regulations to translate these complexities into workable procedures. They may attempt to reach understandings concerning how criteria will be balanced with interest groups active in the regulatory process. But agencies often face imperious deadlines for making regulatory decisions, fragmentary information relevant to many criteria for standard setting, and disputes among interest groups concerning the validity of information and the priorities for criteria in policymaking. In the first years of a new regulatory program, an agency can expect virtually every major decision to be challenged through litigation, usually by an interest alleging the agency has failed to interpret its statutory responsibilities properly.[43]

The Disappearing Threshold

One of the most politically controversial aspects of determining acceptable risk remains the problem of the disappearing threshold, a largely unanticipated problem when Congress wrote most toxic and hazardous substance regulatory laws in the 1970s. Generally, legislators assumed that with many or most regulated substances some threshold of exposure would exist below which the risks to humans or the ecosystem were negligible. Congress certainly did not anticipate removing all traces of human or ecological hazards.

Extremely sophisticated technologies, however, now enable scientists to detect hazardous substances in increasingly small concentrations, currently as small as parts per billion or trillion. It is usually impossible to assert scientifically that such low concentrations are wholly innocent of adverse risk, however slight, to humans or the environment. In addition, the cost of controlling hazardous substances often rises steeply as progressively higher standards are enforced; for instance, after reducing 85 percent of a substance in a waterway, it may cost half as much or more to remove an

additional 5 to 10 percent. In effect, the risk threshold once presumed by policymakers has vanished; no measurable concentration of a substance apparently can be assumed innocent of potential harm to humans or the environment. To eliminate conclusively *any* probable risks from such substances, regulators would have to require the total elimination of the substance, an extraordinarily expensive undertaking. Should a trade-off be made between the costs and benefits of risk prevention, and if so, what criteria should govern the choice?

Critics assert that regulators should err in this trade-off on the side of caution by insisting on extremely high standards for controlling risks and without sensitivity to the economic burden imposed on regulated interests.[44] This may leave the public with unrealistic expectations about the benefits, which in most cases will be extremely small if not undiscoverable when regulators insist on eliminating even minuscule risks from hazardous substances.[45] Often, advocates of strict regulation are indignant at the suggestion that human lives may be endangered if the cost of protection is deemed excessive—an assertion, skillfully delivered, that implies that officials are venal or inhumane for imperiling lives to save money for a regulated interest. Elected officials are understandably wary when dealing with these publicly sensitive issues. It is easy to make tolerance for even small risks appear to be cruel gambling with the destinies of innocent people, even though risk assessment deals in probabilities, not certainties, of accident, death, or disease.

Risk Assessment Reconsidered: The Precautionary Principle

Considering the challenges involved with traditional risk assessment, is there a better way to deal with environmental risks? Environmentalists, together with many related scientists, public health authorities, and policy professionals have vigorously promoted the precautionary principle as an approach to risk management quite different and, they believe, less complicated and more environmentally protective than the current federal method of risk assessment.[46] The *precautionary principle,* in one widely accepted interpretation, declares, "when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically."[47]

The principle has been widely adopted and implemented in EU environmental legislation and in such important international environmental agreements as the Montreal Protocol on Ozone (1987), the Rio Declaration (1992), and the EU Stockholm Protocol on Persistent Organic Pollutants. It is the premise undergirding the global movement to control

greenhouse gas emissions. Proponents of the precautionary principle assert that it has several advantages over traditional risk assessment:

- It mandates preventive action in the face of uncertainty rather than waiting for the determination of acceptable risk and the resolution of all the many scientific controversies often involved in regulating possible hazards.
- It shifts the burden of proof to the proponents of an activity or chemical, who assume the obligation to establish the safety or acceptability of the suspected hazard.
- It promotes the exploration of a wide range of alternatives to possibly harmful actions, including the possibility of not creating the potential hazard.
- It encourages public participation in decision-making by requiring transparency and stakeholder participation.[48]

Proponents of the precautionary principle would contend, for example, that if these principles had been invoked in the regulation of dioxin, much of the previously described political controversy, enormous consumption of time, seemingly interminable litigation, and perhaps unsolvable scientific disputes about acceptable risk could have been avoided, while the human and environmental danger from dioxin exposure would have been more rapidly reduced. In effect, the precautionary approach insists that, even if errors may occur, it is better to err on the side of caution when deciding how to manage a suspected hazard.

The precautionary principle, however, also entails potentially significant risks that prompt others to caution against its widespread adoption. Perhaps the most fundamental concern, as one regulatory expert asserts, is that "it seeks to stop innovation before it starts."[49] The precautionary principle may stifle important commercial, scientific, or economic initiatives whose possibly substantial benefits will be lost—what economists call the *opportunity costs*—because real or suspected hazards may also be involved. In addition, some urgent problems may be unsolvable without significant real or anticipated risk.

The principle may also be applied prematurely. Consider the widely reported appearance of Colony Collapse Disorder (CCD) among honey bees and related pollinators worldwide. Beginning in 2006, domestic beekeepers reported hive losses of 25 to 36 percent, most in hives where the symptoms were unrelated to known reasons for bee deaths. Since honey bees pollinate almost three-fourth of the most common food crops, the apparently sudden, severe decline in the bee populations persuaded some scientists and food experts to warn of an ominous threat to the national food system.[50] During the succeeding years, the national media widely

disseminated the CCD story, often citing suggestions by some apparently reliable sources that a gradual, catastrophic collapse of the national food supply caused by CCD might occur—a 2013 *Time* cover story, for example, ominously titled "A World Without Bees" warned about "the price we'll pay if we don't figure out what's killing the honeybee."[51] The *Time* article, like many other CCD stories, suggested that the bee killer was probably a class of common agricultural pesticides called neonicotinoids. Some fragmentary, seemingly credible evidence did imply that neonicotinoids *might* be the hive destroyer.[52]

Based on the available, if tentative evidence, by 2014 a well-organized campaign had been organized by pesticide critics to convince the EPA to immediately prohibit the application of neonicotinoids to agricultural food crops. If EPA's regulatory authority had been based on the precautionary principle, the agency might have had sufficient evidence to suspend application of neonicotinoids to food crops, at least temporarily. However, this would probably have been unwise. Continuing research available by 2016 suggested that neonicotinoids were only one among many plausible causes of CCD, including bee mites, poor management practices, newly emergent diseases, and food crop change. Some scientific journals, popular news media, and respected researchers have proposed that no CCD epidemic exists or that the evidence is more speculative than had been assumed.[53]

The precautionary principle, at the very least, would require policymakers and regulators to learn an unfamiliar way of thinking about risk management. "Teaching ourselves and our leaders a persistent precautionary approach," observes one scientist, "is like learning to tie shoes by following instructions. It's hard to do at first and may require justification, repetition and reassurance."[54]

The Value of Science in Environmental Policymaking

Despite the scientific disputes attending environmental policymaking, it remains important to recognize how often science provides useful and highly reliable guidance to policymakers. Often, the scientific data relevant to an issue clearly point to the adverse effects of substances and define the magnitude of their risks. This was certainly evident in the data leading to the federal government's decision to ban most domestic agricultural uses of the pesticides dichlorodiphenyltrichloroethane (DDT), aldrin, and dieldrin, for instance. Furthermore, even when one set of data does not alone provide definitive evidence of human risks from exposure to chemicals, numerous studies pointing to the same conclusion taken together can provide almost irrefutable evidence; such was the case in the epidemiological evidence indicting asbestos as a human carcinogen.

Often, the reliability of data will be routinely challenged by those opposed to the regulation of some substance, regardless of the ultimate merit—or lack thereof—of their case. In the end, public officials must make decisions on the basis of the best evidence available. For all their limitations, scientific data often enable officials to define more carefully and clearly the range of options, risks, and benefits involved in regulating a substance, even when the data cannot answer all the questions of risk conclusively.

Even if indisputable data were available on the risks of human exposure to all levels of a substance, controversy over the acceptable level would continue. It is asserted sometimes that science should be responsible for determining the magnitudes of risk from exposure to chemicals and that government should define the acceptability. In other words, defining *acceptable risk* is largely a political matter. Such a division of labor is rarely possible. Scientists, too, are often drawn into the nettlesome problem of determining what levels of exposure to substances ultimately will be acceptable.

Risk and Discrimination: The Problem of Environmental Justice

In October 1997, a jury in New Orleans in a landmark decision awarded $3.4 billion in damages to eight thousand people who had been evacuated a decade previously from their community near a major train route after a tank car filled with the chemical butadiene had caught fire. This award was the largest liability ever assessed in federal court on the basis of environmental discrimination. The fact that most of the plaintiffs lived in a poor, underprivileged neighborhood and thus were exposed to *environmental racism* appeared to have been a major consideration in the jury's generous damage award, even though the plaintiffs' attorneys had only alluded to such racism during the trial. "No one said this is racism," explained one of the lawyers for the neighborhood, "but the facts were such that any commonsense appraisal would tell you that the poorer, underprivileged neighborhood was discriminated against."[55]

It is testimony to the present political potency of the environmental justice movement in the United States that, merely a decade previously, the idea of environmental racism was virtually unknown in public discourse and in the language of the courts, let alone as a cause for civil damage claims. Now, issues of environmental justice—or environmental equity—are raised in so many different political and judicial venues that the language has become almost a staple in political discussions involving minorities and health risks. One of new EPA Administrator Lisa Jackson's earliest administrative decisions was to declare environmental justice an

agency priority. "I want to see a full-scale revitalization of what we do and how we think about environmental justice," she asserted. "This is not an issue we can afford to relegate to the margins. It has to be part of our thinking in every decision we make."[56]

What Is Environmental Justice?

No consensus exists in law or political debate on the meaning of *environmental justice* or about *environmental equity* and *environmental racism*—two terms often used interchangeably with environmental justice. After considerable difficulty, the EPA in 1994 decided that environmental justice should be taken to mean "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation or enforcement of environmental laws, regulations, and policies."[57] In February 1994, President Clinton issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which identified environmental injustice as "disproportionately high and adverse human health or environmental effects created by [executive agency] programs, policies, and activities on minority populations and low-income populations . . ." In contrast, Robert D. Bullard, an environmental justice scholar and leading national advocate for the environmental justice movement, equates environmental justice with the elimination of environmental inequity, which he suggests has at least three implications:[58]

- *Procedural inequity.* The extent to which governing rules, regulations, and evaluation criteria are not applied uniformly. Examples of procedural inequity are holding hearings in remote locations to minimize public participation, stacking boards and commissions with pro-business interests, and using English-only material to communicate to non-English-speaking communities.
- *Geographical inequity.* A situation in which the direct benefits, such as jobs and tax revenues, from industrial production are received by some neighborhoods, communities, and regions, but the costs, such as the burdens of waste disposal, are fixed elsewhere. For example, communities hosting waste-disposal facilities receive fewer economic benefits than do the communities generating the waste.
- *Social inequity.* The extent to which environmental decisions mirror the power arrangements of the larger society and reflect the still-existing racial bias in the United States. Institutional racism, for instance, influences the siting of noxious facilities, placing many black communities in so-called sacrifice zones.

Whether or not it is also linked with equity or racism, the concept of environmental justice is commonly evoked in situations in which identifiable minorities have been exposed, deliberately or not, to disproportionate health or safety risks from a known hazard, such as a chemical waste dump or an environment-polluting industrial site. Still, practically every definition of environmental justice or related terms abounds in ambiguities—what, for instance, constitutes a disproportionate health risk, and how is *minority* defined?

As these definitions demonstrate, the advocates of environmental justice now use the term or its close relations to embrace an enormous diversity of political and economic practices far surpassing the human health and safety issues traditionally associated with environmental risk. Here are a few examples:

- In 2012, the North Carolina Environmental Justice Network collaborated with state water conservation organizations to initiate a lawsuit against a Jones County hog farm that discharged into the Trent and Neuse Rivers the animal wastes from a ten thousand-hog concentrated feeding operation and, the alliance asserted, exposed local residents and river recreationists to excessive and disproportionate risk from waterborne health hazards.[59]
- In 2010, the EPA, in cooperation with Maryland environmental justice groups and Maryland's Commission for Environmental Justice and Sustainable Communities, initiated an aggressive investigation into the scope and risk of local water well contamination created from disposal of toxic coal waste from the Mirant Mid-Atlantic's Chalk Point power plant.[60]
- In Texas, where research suggests Hispanics living near coal-fired electric utilities are disproportionately exposed to hazardous air pollutants, Hispanic environmental justice advocates have joined other state environmental organization in initiating a vigorous campaign to inform and to mobilize Hispanics for political action, demanding more vigorous state and federal regulatory control over such exposures.[61]

It has been left to the courts, legislators, advocacy groups, and scholars to render order from this definitional confusion as they struggle to translate such abstractions into law and political practice. More important than its precise definition, however, is the concept's social impact. From an inauspicious beginning in the mid-1980s, the movement has gradually become a potent political force. Its most important impacts have been to compel government attention at all levels to issues of environmental discrimination, to motivate grassroots political movements

nationwide that mobilize minorities against apparent environmental discrimination, and to bring environmental discrimination within the scope of judicial concern and remedy.

A Growing Movement

The environmental justice movement achieved major national attention in 1991 when six hundred delegates met in Washington, D.C., at the first National People of Color Environmental Leadership Summit. From its inception, the movement's relationship to mainstream environmental advocacy groups has been ambivalent. "For the most part," observes historian Martin V. Melosi, "the movement found strength at the grassroots, especially among low-income people of color who faced serious environmental threats from toxics and hazardous wastes."[62] Thus, the movement assumes a very different social and economic aspect from the predominantly middle-class, white, and relatively affluent organizations dominating U.S. environmental politics. Moreover, the movement's agenda focuses primarily on local communities, toxic and hazardous waste sites, and new organizational identities. At the same time, environmental justice generates a political gravity that can draw minority advocates into a closer political orbit with organized environmentalism. Mainstream environmental organizations have been quick to recognize that environmental justice offers an opportunity to attract economic and racial minorities to the environmental movement and to overcome persistent criticism that environmentalism is or appears to be a "white thing." The Sierra Club's National Environmental Justice and Community Partnerships and the National Resources Defense Council's Environmental Justice Website are two among many illustrations of this strategy. Environmental justice organizations, for their part, often create strategic partnerships with mainstream environmental advocacy groups when this works to their political advantage, yet the movement insists on maintaining an identity apart from mainstream environmentalism.

The environmental justice movement has relied primarily upon three federal enactments to provide a basis for administrative or legal action against governmental or private entities alleged to be responsible for environmental injustice. Two of these measures have been President Clinton's Executive Order 12898, noted earlier, and the EPA's 1994 guidelines for environmental justice (currently called Plan EJ 2014). The executive order requires federal executive agencies to identify and eliminate environmental injustice as part of their mission. While the executive order compels federal administrators to implement a policy of environmental justice, it is also limited because it is not enforceable in court and does not create any rights or remedies.[63] The EPA's Office of Environmental Justice,

created also in 1994, has been responsible for promoting the EPA's environmental justice guidelines throughout the agency's organization and programs, although like Executive Order 12898, it neither creates judicially recognizable rights nor authorizes the courts to enforce it. The third foundation for political and legal action, Title VI of the Civil Rights Act (1964), has been interpreted by the federal courts to include a substantive and enforceable right to environmental justice, although Title VI does not mention environmental justice explicitly.

The movement's fundamental conviction that cultural, racial, and ethnic minorities have been exposed disproportionately to health and safety risks throughout the United States has inspired an aggressive campaign to identify and mobilize these minorities, to demand various forms of compensation for those afflicted by such discrimination, and to demand that governmental policymaking be redesigned to weigh issues of environmental equity in environmental policymaking. The movement has been aided powerfully by active support from numerous social action organizations affiliated with many of the nation's major religious denominations. The movement has also been alert to the environmental justice implications of the global climate change issue, and in mid-2000, a new climate justice movement emerged from the organizational base. "Climate change is the most significant social and political challenge of the 21st Century," a leadership manifesto declares, "and the time to act is now." This new climate agenda "must be just, fair, sustainable, and equitable" and should, among other goals,

- establish a zero-carbon economy and achieve this by limiting and reducing greenhouse gas emissions in accordance with the levels advocated by the scientific community
- protect all of America's people—regardless of race, gender, nationality, or socioeconomic status—and their communities equally from the environmental, health, and social impacts of climate change
- ensure that carbon reduction strategies do not negatively impact public health and do not further exacerbate existing health disparities among communities
- require those most responsible for creating the impacts that arise from climate change to bear the proportionate cost of responding to the resulting economic, social, and environmental crisis.[64]

The environmental justice movement has grown in size, organizational skill, and political influence. In 2000, the movement was estimated to include approximately 400 organizations. By 2010, one directory listed more than 800 groups (many of these are small and transitory, however).[65] This may, however, greatly underestimate the strength of the movement

because it does not include a number of other organizations that have actively adopted environmental justice as a part of their larger agendas in recent years. "The last decade has seen some positive change in the way environmental groups in the United States relate to each other around health, environment, economic, and racial justice," notes a 2011 survey of national environmental justice activism. "An increasing number of community-based groups, networks, university-based centers, environmental and conservation groups, legal groups, faith-based groups, labor, and youth organizations have formed partnerships and collaboratives to address environmental and health issues that differentially impact poor people, people of color, and children. The number of people of color environmental groups has grown from 300 groups in 1992 to more than 3,000 groups and a dozen networks in 2011."[66] The movement's impact has been magnified enormously in recent years as the result of an enlarging, increasingly skillful network of collaborating local, state, and national organizations. The Internet has provided a highly congenial and virtually costless venue for network development. Especially significant in enlarging the resource base and intellectual breadth of the environmental justice movement has been the rapid expansion of college- and university-based environmental justice research, teaching, and advocacy centers. Among the earliest of these were the Clark Atlanta University's Environmental Justice Resource Center and the University of Michigan's Environmental Justice Program and Multicultural Environmental Leadership Initiative. By 2011, there were "13 university-based environmental justice centers, four of which are located in Historical Black Colleges and Universities . . . 22 legal clinics that list environmental justice as a core area, and six academic programs that grant degrees in environmental justice, including one legal program."[67] Other professionally related programs include the Energy Justice Network; advocacy specialists in the American Bar Association, the Environmental Law Institute, and other professional legal associations; and a multitude of independent legal and paralegal entities at all government levels. The EPA maintains a very substantial environmental justice website. Another website creates an environmental justice scorecard for communities, based on federal toxic emissions reports, that "profiles environmental burdens in every community in the U.S., identifying which groups experience disproportionate toxic chemical releases, cancer risks from hazardous air pollutants, or proximity to Superfund sites and polluting facilities emitting smog and particulates."[68] In addition, specialized environmental justice media are increasing, such as the Inner City Press's *Environmental Justice Reporter*. The movement's leadership now embraces virtually all people of color and all the economically disadvantaged within its mission, so that Native Americans, Latinos, and Asians, among other important domestic minorities, are being recruited.

This growing coalition committed to social equity in environmental regulation illustrates why the creation and solution of environmental risks are often inherently a political issue. In early 1994, President Clinton issued Executive Order 12898, instructing all federal agencies to develop strategies to ensure that their programs "do not unfairly inflict environmental harm on the poor and minorities."[69] Since the EPA created its Office of Environmental Justice in 1992, numerous state and local governments have also declared a commitment to environmental justice by law or executive order. In early 2004, for example, New Jersey's governor issued an executive order that mandated the state's Departments of Environmental Protection and Transportation develop a strategy to reduce pollution exposure in minority and low-income neighborhoods.

Environmental Justice and the Courts

Despite occasional judgments entailing large financial awards for plaintiffs claiming significant harm as a result of environmental injustice, state and local courts, where such litigation typically originates, have not proven to be a major venue for the environmental justice movement. A major reason is that most states lack appropriate statutory or administrative enactments creating a basis for legally enforceable rights, claims to damage, or other awards based upon evidence of environmental injustice. Only six states, for example, have enacted legislation creating a judicially enforceable right to environmental justice. Nineteen states have not yet enacted any measures to address environmental justice, while the remaining states have taken a variety of actions, such as creating study commissions or state boards to identify issues of environmental injustice and to promote their resolution.[70]

The federal courts, however, have been more receptive to litigation based on claims of environmental injustice, based primarily upon Title VI of the Civil Rights Act (1964), which prohibits major forms of discrimination against racial, ethnic, national, and religious minorities and women.[71] Using Title VI for leverage, environmental justice advocates have achieved modest but important progress in enforcing civil rights, criminal penalties, and civil financial awards against public and private institutions based upon claims of discrimination based upon environmental evidence. The EPA, for instance, is among many federal agencies that have used the Civil Rights Act as well as President Clinton's executive order to initiate environmental justice activities.

Administrative Challenges

Administering laws that mandate environmental justice has been labored and controversial from its inception. Stakeholders may agree on

its necessity, yet translating environmental justice into public policy—like implementing other public laws—can manufacture formidable obstacles between the word and the deed.

Laggard Federal Agency Initiative. One major obstacle has been the frequent lack of resources and (sometimes) resolve among federal agencies to implement aggressively their environmental justice mandates. The EPA, in particular, has constantly struggled with impediments, not all of its own creation, in enforcing its environmental justice regulations and Executive Order 12898. At the beginning of the Obama administration, eighteen years after Clinton's Executive Order, a very careful review of EPA's implementation concluded that the EPA had "repeatedly and systematically failed to incorporate environmental justice considerations into core programs and decision-making."[72] These problems promoted Obama's Administrator Lisa Jackson's promise of "a full-scale revitalization" of the environmental justice program.[73] Some of these problems arose from White House failures to fund generously the agency's environmental justice activists and from the meager data sometimes available to characterize environmental justice conditions.

By 2015, the prospects for implementation of Executive Order 12898 seemed to improve significantly. The earlier, critical report also noted: "Former Obama Administrator Lisa Jackson prioritized environmental justice during her time at the Environmental Protection Agency, and the issue has remained on the agency's agenda under the leadership of current Administrator Gina McCarthy. For the first time in two decades, the EPA is taking significant new steps to translate Clinton's Executive Order 12898 into future routines as part of its *Plan EJ 2014* initiative. If consistently implemented, a number of new Agency policies and guidance directives could together create real momentum toward improving environmental conditions in minority and low-income communities."[74] Often, however, continual pressure by environmental justice organizations is required to compel careful attention to environmental justice issues at the EPA and other federal agencies. The EPA's own National Environmental Justice Advocacy Council, the agency's primary environmental justice advisory group, has asserted that among the compelling reasons the agency should use the CAA to create regulations preventing terrorist attacks and accidents at chemical facilities is that disadvantaged populations constitute a large proportion of the populations at risk at 483 chemical facilities in forty-three states.[75]

The Challenge of Data Quality and Availability. While scientific data relevant to environmental justice problems has been improving significantly since the mid-1990s, almost all discourse about environmental

justice—whatever the venue—is still likely to ignite controversy over the scientific basis of claims to environmental injustice.[76] Fragmentary evidence accumulating for decades and more deliberate studies in recent years often seem to demonstrate that minorities and poor individuals are disproportionately exposed to health risks from environmental pollutants.[77] The economically disadvantaged may also be more likely than others to have a hazardous waste site for a neighbor. Several studies have suggested as much; for example, one Detroit, Michigan, survey, cited by sociologists Paul Mohai and Bunyan Bryant, indicated that "minority residents in the metropolitan area are four times more likely than white residents to live within a mile of a commercial hazardous waste facility."[78]

Still, significant problems remain in assembling and interpreting the social, economic, and scientific data essential as evidence of environmental injustice. One problem is the frequent difficulty of obtaining basic information about population exposures to environmental risks that is sufficiently rich in detail and covering long-enough periods to satisfy the requirements of common risk assessment methods. With the exception of lead exposure, little reliable evidence has existed before 2000 about the specific relationship of race or class to environmental health measures. Moreover, even when considerable evidence exists that disadvantaged populations have frequently experienced higher levels of exposure and risk from environmental hazards when compared to more advantaged groups, the data concerning the long-term health impacts are often meager or missing. Additionally, it is difficult with existing data to demonstrate that adverse health impacts among disadvantaged populations exposed to environmental hazards are caused primarily or in significant measure from these exposures among the many other plausible causes of ill health.[79] Especially when there is a possibility of population exposure to multiple environmental hazards—a situation quite common in minority communities—the appropriate scientific protocols for estimating individual or population exposure have seldom existed and almost never existed before 2000 for regulatory decision-making.

An additional obstacle is demonstrating that economic or racial minorities have been exposed deliberately to disproportionate environmental risks or that risk exposures were assumed involuntarily. For example, it may be demonstrated convincingly that populations living for decades near a known environmental hazard (such as a petrochemical plant) are largely poor, racial minorities and that they are more heavily exposed to environmental pollutants than nonracial minorities in the same community. Yet it may be argued in political debate and courtrooms that such individuals often moved to their residences deliberately and with knowledge of the environmental risks so that the environmental exposures were voluntary.

Finally, difficulties arise over the appropriate strategies for identifying how risks may be distributed unfairly in environmental regulation and how this inequity can be solved. Over how long a period, for example, should risk estimates be made? Which populations qualify as disadvantaged? To what extent should the ability of individuals to protect themselves from such risks be taken into account? What sort of environmental risks should be included? How can such issues be introduced early enough in the regulatory decision-making process to influence the outcomes?

For environmental justice advocates, however, the available evidence of injustice seems convincing if not overwhelming. For example, a policy paper by one major advocacy group begins, "Although communities of color, tribes and indigenous peoples, and the poor have been heavily and disproportionately affected by noxious risk producing environmental practices for decades," as if stating common knowledge.[80] At the other extreme, Christopher H. Foreman Jr. of the Brookings Institution completed an extensive study of claims made by environmental justice advocates and concluded that

> [W]hen you clear away all the smoke blown over risk and racism in recent years, there turns out to be remarkably little good evidence indicating that low-income and minority citizens regularly bear a disproportionate share of society's environmental risk, much less that they develop pollution related illnesses more often than other citizens.[81]

Environmental Justice and Politics

Surveying these difficulties, critics have argued that the environmental justice agenda is ultimately a means to much broader political ends. The movement's political potency, so the argument runs, is grounded less on scientific credibility than on the capacity of its grassroots organizers to mobilize minorities and to articulate deeply rooted historical social grievances for which environmental issues are often symbolic. "It effectively speaks to the fear and anger among local communities feeling overwhelmed by forces beyond their control, and outraged by what they perceive to be assaults on their collective quality of life," Foreman concludes.[82] To the movement's leadership, such assertions are likely to appear to be an effort to deflect attention from the evidence of environmental injustice by implicitly attacking the motivation of its leaders.

In any case, the environmental justice movement now claims a salience on the agenda of national environmental policy that is unlikely to decline in the near future. For the nation's governments, one of the most daunting challenges is to find a way to effectively translate lofty goals, such as environmental equity or environmental justice, into specific policy procedures

and specific governmental actions. How do we bring environmental justice to the desktop and conference table of routine governmental regulation? It seems evident that a successful policy translation will require, at least, the rapid development of a science base, which means acquiring and disseminating information about the exposure of minority populations to specific environmental hazards and developing reliable methodologies for estimating individual and population risks from such exposure. Administrative law and procedure must be modified in detail and depth so that considerations of inequitable environmental risk can be considered in a timely and explicit manner in regulatory decision-making. Converting prescription into practice will be arduous, however, in light of the current disagreement on appropriate metrics for measuring discrimination and equity and on the degree of difference among populations that constitutes inequity.

Conclusion

The complex new problems of risk assessment in environmental regulation confirm that we live in a historically unique era of technocratic power. U.S. science and industry, in common with those of other advanced industrial nations, now possess the capacity to alter in profound but often unpredictable ways the biochemical basis of future human life and thus to change future ecosystems radically. In its extreme form, represented by nuclear weapons, modern technology has the power to eradicate human society, if not humanity itself. But modern technologies also can alter the future ecosphere in a multitude of less-dramatic but significant ways: through the deliberate redesign of genetic materials in human reproduction, through the depletion of irreplaceable energy resources such as petroleum or natural gas, through the multiplication of long-lived hazardous substances whose biological impacts on humans and the ecosystem may magnify through hundreds of years, and many more. We are practically the first generation in the world's history with the certain technical capacity to alter and even to destroy the fundamental biochemical and geophysical conditions for societies living centuries after ours. It is, as one social prophet noted, a power that people of the Middle Ages did not even credit to devils.

With this new technocratic power comes the ability to develop technologies, to manufacture new substances, and to deplete finite resources so that the benefits are largely distributed in the present and the risks, for the most part, are displaced into the future. Future societies may inherit most of the burden to create the social, economic, and political institutions necessary for managing the risks inherent in this generational cost

transfer. Such technical capacity can become an exercise of power undisciplined by responsibility for the consequences.

The status of nuclear wastes in many ways provides a paradigm for this problem. Because the wastes from civilian nuclear reactors currently cannot be recycled, as was assumed when the nuclear power industry began in the United States during the 1950s, the federal government now must find a safe and reliable way to dispose of the growing amount of nuclear wastes from these facilities.

Among the most dangerous of these substances are high-level wastes—those highly toxic to humans for long periods—found in the spent fuel rods from civilian reactors. Strontium-90 and cesium-137, for instance, must be isolated from human exposure for at least 600 years; other high-level wastes must be isolated for perhaps 1,000 years. Equally dangerous and much more persistent are the transuranic wastes forming over long periods from the decay of the original materials in the spent fuel rods after they are removed from the reactors. Plutonium-239 remains dangerous to most species for at least 24,000 years, perhaps for as long as 500,000 years. This plutonium, noted one commentator generally sympathetic to the nuclear power industry, "will remain a source of radioactive emissions as far in the future as one can meaningfully contemplate."[83] Other transuranics include americum-241 (dangerous for more than 400 years) and iodine-129 (dangerous for perhaps 210,000 years).

Practically speaking, such figures mean that hazardous wastes must be prevented from invading the ecosystem for periods ranging from centuries to hundreds of millennia. Not only must they be securely isolated physically, but also human institutions must survive with sufficient continuity to ensure their responsible administration throughout these eons. Many other chemicals created in the past few decades, including widely used pesticides such as DDT, 2,3,5-T, and dieldrin are not biodegradable and may persist throughout the world ecosystem indefinitely. Although less dangerous than nuclear wastes, these and other substances also represent a displacement of risks to human health and to the ecosystem well into the future.

This transfer of risk raises fundamental ethical and social questions for government. Should public institutions be compelled in some formal and explicit way to exercise regard for the future impact of decisions concerning environmental management today? And if so, how much regard? When deciding whether to develop dangerous technologies, should government be forced, if necessary, to consider not only the future ecological implications of these technologies but also the ability of future societies to create institutions capable of controlling them?

This issue is significant, because government and economic institutions have a tendency to discount the future impacts of new technologies or

newly developed chemicals when compared with the immediate impacts. In economic terms, this is done in formal cost–benefit analysis by discounting future benefits and costs rather substantially. In political terms, it amounts to adopting a strategy that favors taking environmental actions on the basis of short-term political advantage rather than long-term consequences. (Elected officials, especially, often treat as gospel the legendary advice of a former House speaker to a new colleague: Remember that when it comes time to vote, most folks want to know, "What have you done for me lately?") It is particularly difficult for public officials to develop a sensitive regard for the distant future when there are no apparent political rewards for doing so. At some time, the political cynic in practically all public officials whispers, "What has posterity done for you lately?"

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