

## ENVIRONMENTAL PLANNING AND POLICY IN A POST-RIO WORLD

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### Abstract

*A growing sense of an international environmental crisis has brought new attention to the field of environmental planning and policy, yet many of the planning techniques and policy mechanisms in the field reflect the characteristics of environmental problems from the late 1960s and 1970s. The challenges of the 1990s are quite different from those facing environmental planning and regulatory agencies when those agencies were first established, and several emerging trends could compel new approaches to environmental planning and policy. This article discusses five major trends and their implications for environmental planning and policy in the coming decade. Together, these trends will require environmental policymakers to rely more upon incentives-based regulatory approaches that address the cumulative effect of many small, dispersed, ubiquitous emission sources that could have global impacts. This new challenge contrasts sharply with the historic regulatory approach in the United States, which has emphasized technology-oriented, standards-based, command-and-control regulation of large, centralized point sources of pollution emissions. Unless environmental planning and policy institutions adapt to this new environment, however, they will not succeed.*

The recent United Nations Conference on the Environment and Development (UNCED) in Rio de Janeiro focused world attention on the global importance of environmental issues in the 1990s. The so-called "Earth Summit," which was held June 3-14, 1992, brought together nearly 100 heads of state, the largest gathering for any purpose in the history of the planet, and 178 nations were represented. While many question whether the Rio conference yielded anything of substance, it clearly marked a significant turning point in the institutional development of environmental planning. The presence of so many heads of state legitimized the critical importance of environmental issues on the global agenda. As with the Helsinki Accords of 1975, the lack of substance in the language of the Earth Summit treaties may be overshadowed by the importance of increased international attention on the environment.<sup>1</sup>

Increased international attention on environmental issues does not simply mean an acceleration and intensification of effort to conduct environmental planning through the business-as-usual means. A closer look at the underlying causes of the current environmental crisis reveals that the challenges of the 1990s are quite different from those of the 1970s, when environmental planning and policy were first institutionalized by governments. Several general trends are now emerging that are likely to change the way planners and policymakers tackle environmental problems. Using examples largely from the United

States, this article describes five of the most important policy trends and discusses their environmental planning implications:

- 1) The Globalization of Environmental Impacts;
- 2) The Democratization of Pollution Sources;
- 3) The Shift to Life-Cycle Impact Analysis;
- 4) The Shift from Regulating Emissions to Limiting Exposures; and
- 5) The Shift to Incentives-Based Regulation.

These trends cut across substantive issue areas that have traditionally been the organizing framework for environmental institutions and policies and are likely to affect all of these traditional issue areas in the 1990s. They offer a conceptual framework for consideration of those substantive issues and analysis of the policy alternatives that may be proposed in the coming decade. They also differ significantly from the traditional policy approaches to environmental planning and regulation.

The National Environmental Policy Act (1969) and related state statutes require government agencies to generate environmental information and consider it in their decision-making processes (Ortolano 1984, Rosenbaum 1977). Most pollution control programs in environmental planning and regulation focus on the private sector, however, and they usually rely upon technology-forcing regulatory standards that require end-of-the-pipe waste treatment. This "command-and-control" approach emphasizes emission and effluent reductions at centralized facilities through engineering-oriented solutions (Masters 1974).

This technological orientation reflects both the historical origins of public health and public works agencies (Petulla 1987) and the characteristics of the pollution problems originally tackled (Alm 1992, Andrews 1992). The federal Clean Air Act (1970) established a regulatory framework to reduce emissions from centralized stationary and mobile sources through the use of technological controls. The Federal Water Pollution Control Act or Clean Water Act (1972), which was supplemented by construction grants to build public sewage treatment plants, followed a similar model. These approaches generally resulted in visible reductions in many pollutants, but they often shifted residuals to landfills (Ortolano 1984, Portney 1990).

Concern about the risk of toxic contamination from hazardous waste led to the second wave of federal environmental regulation. The Resource Conservation and Recovery Act (RCRA, 1976) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund," 1980) made the 1980s a decade for increased attention on landfill siting and operation, and the management of hazardous wastes. Invariably, conflicts have occurred between land-, water, and air-based disposal options (Ortolano 1984). These conflicts have led many policymakers to question some of the fundamental principles underlying existing American environmental regulation. The emerging trends of the 1990s reflect both the success and failure of the 1970s and 1980s.

Both the concerns of and participants in environmental policy have changed considerably during the past two decades. While most government regulatory programs were starting from scratch in the late 1960s and early 1970s, both regulatory agencies and advocacy groups are well-established in the 1990s. Public awareness of environmental problems is now considerably higher (Dunlap 1985, Dunlap 1987), while the complexity of the issues seems to have

increased manifold. From local land use controls to international negotiations on global warming, environmental issues now affect every political institution. Environmental issues could become the dominant political issue of the 1990s. They hold the potential to transform everything from international security (Core 1992, Myers 1987, Mathews 1989a) to inner-city crime and poverty.<sup>2</sup> Identifying and understanding these underlying trends will help policymakers and planners make decisions that reflect the changes in our understanding of environmental issues.

This discussion synthesizes the views of leading planners, scientists, engineers, economists, activists, journalists, and environmental policy-makers. It represents a *qualitative* assessment of trends which are likely to have a significant impact on a wide number of issues. While these trends may not affect every issue, they are the broad waves that are carrying environmental planning and policy into the post-Rio world. Some are the result of inherent problems in the regulatory approaches of the past twenty years, while others are recent responses to new problems. None can be ignored.

### The Globalization of Environmental Impacts

Environmental problems are increasingly becoming global (Graedel 1989, Hoffman et al. 1986, Clark and Munn 1986, Core 1992). In parallel with the development of more far-reaching, global economic linkages, this "globalization" of environmental impacts has important implications for international relations. This has already brought new institutions into the arena of environmental policy, including the U.S. Departments of State, Defense, and Commerce.<sup>3</sup> Domestic policy will require improved and expanded coordination with internationally-determined policy objectives. The means for achieving policy objectives remains a task for domestic policy, but other nations' agendas now affect the definition of domestic policy objectives.

The globalization trend could have reached a crescendo in the Rio agreements, but the U.S. effectively avoided any direct international control over sovereign nations' activities by weakening the global climate change agreement and refusing to sign the biodiversity agreement. Diplomatic pressure from other countries for stricter timelines and implementation efforts that could include some international enforcement "teeth" is now expected. The twelve nations of the European Community (EC) have already signed a separate agreement, promising to reduce carbon dioxide emissions (CO<sub>2</sub>) to 1990 levels by the year 2000. They may now be expected to apply behind-the-scenes pressure to get a similar commitment from the U.S.<sup>4</sup>

Moreover, the Rio conference established a new "Commission on Sustainable Development" that may ultimately be strengthened with some enforcement power. Its initial role will be that of only a data gatherer and monitor, but this problem-defining and agenda-setting role can have a significant impact on policies (Innes 1990). The critical determinant of its effectiveness will be funding. The 1972 United Nations Conference on the Environment<sup>5</sup> led to the formation of the United Nations Environment Programme (UNEP), but the Programme's effectiveness has been hampered by budgetary constraints throughout its first two decades of existence. Because the industrialized countries have very little direct control over autonomous U.N. agencies, the U.S. is calling for any increases in global environmental aid to be channeled through the World Bank's

new Global Environmental Facility (GEF), where management control is based upon the level of each country's financial contributions to the overall pool.<sup>6</sup>

The Montreal Protocol and Toronto Accord on Atmospheric Ozone depletion may serve as models for future international cooperation on global climate change, just as the Law of the Sea Treaty and European agreements on trans-boundary pollution served as models for negotiation of the ozone accords (Benedick 1991). However, negotiations for all of these agreements also demonstrated the difficulty of achieving consensus, in an institutional setting where enforcement mechanisms are weak and countries may have no incentive to cooperate. India and China have refused to sign the ozone treaty, the United States has held out on the Law of the Sea treaty, and both the United States and Great Britain objected to provisions of the trans-boundary pollution agreements on acid deposition. It is difficult to reconcile disparate interests with so much at stake. "Environmental diplomacy" is still in its infancy. Its practice requires a new set of skills in diplomacy, economics, law, science, and environmental planning and policy.

The "Earth Summit" was the direct outgrowth of the 1987 report by the World Commission on Environment and Development (WCED), *Our Common Future*. "The earth is one," began the Brundtland Commission report,<sup>7</sup> "but our world is not." The commissioners concluded by stating, "We are unanimous in our conviction that the security, well-being, and very survival of the planet depend on such [institutional] changes [to encourage environmentally sustainable development], now" (WCED 1987). Timely resolution of the global environmental crisis clearly requires a new level of international cooperation, and the end of the Cold War has opened up the opportunity for such cooperation between the East and West. The challenge now is to address the continuing conflicts between the North and South on these issues. The latter were the focus of controversy at the "Earth Summit."<sup>8</sup>

Despite this controversy, however, the conclusions of the Brundtland Commission are receiving increasingly widespread support (Hill 1989). Rio shifted the debate from *whether* the nations of the world will act on these issues to *how* they will act. This is a significant breakthrough. It moves the challenge of public policy from one of goals and objectives to planning, institution-building, and implementation through concrete actions. The Helsinki Accords in 1975 had a similar effect on the human rights debate.

Establishment of coherent policies to address global climate change requires reconciliation and cooperation between the North and South. Despite some scientific uncertainty,<sup>9</sup> the global warming issue has quickly moved to the policy formulation phase. Policies to address anthropogenically-caused climate change require reconsideration of *fundamental* principles regarding global economic development: population growth, resource exploitation, health care, energy policy, technological innovation, and North-South aid levels. Resolution of any *one* of these issues may require resolution of *all* of them; the developing countries have already demanded such a linkage before they will cooperate on the global warming issue. The globalization of environmental impacts therefore affects many other international and domestic policy concerns (Usher 1989, Myers 1987, Gore 1992).

Even before the threat of global climate change was widely recognized,<sup>10</sup> however, it was already clear that environmental problems do not heed the

jurisdictional limits of our political boundaries. Water resource development from the Colorado River affects relations between the United States and Mexico, for example, while acid deposition from coal plants in the midwestern United States strained relations with Canada throughout the 1970s and 1980s. Norway has told Great Britain that acid rain is as important to bilateral relations as traditional security issues, and it could surpass defense in importance in the post-Cold War era. Sweden is already investing directly in pollution control for Polish factories, since Polish emissions often end up in Sweden. The grave environmental crisis facing eastern Europe may require similar investments by the West to ensure environmentally responsible economic rejuvenation (French 1988, Jacobson 1989). Environmental cleanup is one of the biggest costs now facing the newly integrated Germany.

The garbage of New York City spent a long time on the barge "Mobro" in 1987, looking throughout the world for a dumping ground. Everybody else sent it back "home" to Long Island. There is a new-found recognition that each region will need to address its own environmental problems, and that exporting to other regions is no longer acceptable.<sup>11</sup> Historic concerns over local air quality and water quality gave rise to federal legislation to impose emission and effluent controls, but the new trans-boundary issues are not amenable to simple technological solutions. New models of cooperation and institutional arrangements are required, as well as reassessment of some basic economic assumptions. The globalization of environmental impacts has brought a new era of environmental planning and policy – where diplomacy and the linkages between environmental quality and economic development will be as important as the marginal cost of a catalytic converter (Caldwell 1985, Clark 1989, Ruckelshaus 1989, Perry 1986, Mathews 1989b). Invariably, the need to address both environment and development means that ethics, equity, and justice are becoming more central to environmental planning and policy practice.<sup>12</sup>

### The Democratization of Pollution Sources

While the "globalization" of environmental impacts received the bulk of media and public attention during Rio, perhaps the most important emerging environmental trend is the "democratization" of pollution sources (Wald 1989, Hair 1989): where the aggregate, cumulative impacts of many small, diffuse, and ubiquitous consumer sources are now as significant as a few large "point" or stationary industrial sources. Recognition that everyday economic activities have negative environmental impacts could revolutionize the way we approach environmental problems, both philosophically and managerially. Traditional policy measures – technology-based, centralized, command-and-control regulations on large, stationary, "point" sources – are poorly suited for managing reductions from diffuse sources of pollution.

Industrial polluters have long argued that their production processes were neither malicious nor solely responsible for environmental degradation. Industrial smokestacks and effluent pipes remained easy targets for regulation, however, and control of their end-of-the-pipe discharge promised immediate reductions in pollution. Pollution control strategies therefore focused on *producers* rather than *consumers*.<sup>13</sup> Air and water quality standards were set to compel application of the "best available control technology" (BACT) to reduce plant emissions of criteria pollutants.<sup>14</sup> Following these relatively "easy" (if sometimes costly) gains, the *relative* share of other (non-point) sources is now both greater and potentially more significant in terms of health impacts (discussed

below). New pollution control policies must therefore address those sources directly if policy goals are to be achieved.

The 1989 Air Quality Management Plan for the South Coast Air Quality Management District (SCAQMD) explicitly addressed this new reality (SCAQMD 1989). To resolve the serious air quality problems of the Los Angeles basin, all sources of ozone precursors had to be reduced: stationary point sources (e.g., power plants); stationary non-point sources (e.g., landfills); mobile point sources (e.g., automobiles); and mobile non-point sources (e.g., barbecue lighter fluid use). Moreover, the actual impact of some of these smaller sources on human health may be greater than the traditional targets of environmental regulation. While traditionally-regulated industries continued to face significant compliance costs under the SCAQMD Plan, everyday consumer activities were also targeted (SCAQMD 1989). Consumer use of substances (e.g., volatile organic compounds [VOC]) were estimated to be as significant a source of air quality degradation as production processes (e.g., manufacture of those same VOC).

The economic efficiency of the specific implementation and enforcement measures advocated in the 1989 SCAQMD Plan for control of those diverse sources quickly came under criticism (Krupnick and Portney 1991).<sup>15</sup> More importantly, application of traditional regulatory tools to the "new" problem of reducing these widely dispersed, ubiquitous emissions quickly led to a morass of administrative guidelines that was both unwieldy and difficult to enforce. The SCAQMD therefore adopted a new policy earlier this year<sup>16</sup> to pursue a radically different implementation strategy that relies more on economic incentives. Nonetheless, the 1989 Air Quality Management Plan fundamentally altered the conceptual boundaries of environmental problem-solving by identifying these small, ubiquitous sources as a significant part of the problem. Gasoline evaporation, barbecue lighter fluid use, dry-cleaning processes – all of these are contributors that are much closer to the everyday lives of ordinary citizens. It is no longer possible to blame "them" – large, industrial producers – for the pollution problem. The problems are also due to activities by "us," consumers, through everyday activities. This shift in perspective is now being adopted in state-wide policy, and is likely to spread to other states and nations (California Air Resources Board 1989). California is recognized as a national leader in air quality management policy.<sup>17</sup>

Like the SCAQMD Plan, water quality regulations are also increasingly reflecting the importance of non-point sources.<sup>18</sup> Rainwater runoff from urban streets, irrigated agricultural lands, and poorly managed forestry projects all contribute to water quality problems. Traditional approaches failed to incorporate "soft" technologies, such as better land management techniques, into pollution alleviation programs. End-of-the-pipe *treatment* dominated, rather than pre-runoff *prevention*. The latter is now getting new attention as a solution to the problem of managing many small, diverse, ubiquitous non-point sources.

This change could affect the political viability of environmental control measures. There is now strong public support for environmental protection (Dunlap 1985, Dunlap 1987), but the costs of such protection have traditionally been borne directly by corporations and only indirectly by consumers. Consumers could now face the costs of compliance more directly. This could erode their political support for the measures. Consumers vote directly in elections; producers only participate indirectly. The decentralization of responsibility for environmental costs could lead to either a "backlash" against environmental

protection or a return to a focus on controlling centralized, industrial emissions. The latter does not eliminate the costs of control, but it does tend to make the cost of environmental protection more "invisible."<sup>19</sup>

The conflict between environmental protection and basic freedoms may also lead to a backlash. Perceived rights of mobility associated with automotive use are deeply held, for example, and government "intrusion" into everyday activities (e.g., mowing the lawn, using barbecue lighter fluid) have not been well-received. The SCAQMD Plan is the first real test. Consumers may instead opt for good old-fashioned regulatory approaches and either a lower level of environmental quality or higher costs of meeting environmental policy goals. The democratization trend brings that choice home, whereas the traditional focus of regulatory control does not make the tradeoff explicit. As will be discussed below, the reaction against direct regulatory control over everyday consumer activities has apparently driven the SCAQMD to pursue alternative means of achieving its regulatory ends.

The trend toward "democratization" does not necessarily shift the burden of environmental protection from large industrial producers to residential consumers, but it does have important implications for the efficacy of policy alternatives available to environmental planners. It means that the net of regulatory control will now be cast more widely, affecting every aspect of economic activity. Without a wider regulatory net, environmental quality will continue to degrade and/or the cost of compliance will continue to grow up a steeply rising marginal cost curve. Sharing the burden of reducing emissions could reduce marginal costs in the short run, since many sources have not yet begun to apply the most cost-effective control mechanisms. Economic skills may therefore be more important to environmental planners than engineering knowledge in the new regulatory environment.

### **The Shift to Life-Cycle Impact Analysis:**

#### **"Upstream" Source Reduction and Pollution Prevention**

Environmental improvement (or the arrest of degradation) cannot be achieved exclusively through traditional regulatory approaches that focus on end-of-the-pipe treatment technology. There is therefore now greater attention to the impacts of "upstream" manufacturing processes and the opportunities for "source reduction" and "pollution prevention." The U.S. Environmental Protection Agency (EPA) is developing programs to encourage such management-oriented solutions to environmental problems, to complement technology-based emission standards.<sup>20</sup> Moreover, 3M and other companies have found that "Pollution Prevention Pays" through reduced materials, energy, waste disposal, and insurance liability costs.

Environmentalists and consumers are also now demanding that producers use recycled materials and utilize their market position to encourage more responsible production and delivery of raw materials. Unfortunately, preliminary market evidence suggests that consumers are not generally willing to pay the higher costs initially associated with products made from recycled materials. Those costs may ultimately be lower than for products using virgin materials, however, if all environmental externalities are captured in the product price and economies of scale bring down the per-unit cost of products made from recycled materials.

Effective management of environmental problems requires greater efficiency in manufacturing processes, reuse and recycling of production materials "upstream" within manufacturing plants, and preventive efforts resulting in "waste minimization." It is now widely believed that it is easier to prevent pollution than to try to clean it up in the environment (Oldenburg and Hirschhorn 1987, Plehn and Huisingsh 1985). The problem remains, however, that the responsibility for these two types of costs – prevention versus cleanup— are not necessarily borne by the same parties. The result is a continuing incentive to pollute and no real incentive to develop alternative production processes or more environmentally-sensitive technologies. This is characterized as a "negative externality" in economics, where some of the costs of a market transaction (e.g., pollution damage and clean-up costs) are borne by a third party.

As regulators and environmental activists move to encourage greater "source reduction," global competitive economic forces may become the strongest factor encouraging more efficient production processes. International competition is affecting many important U.S. industries, and the most successful foreign competitors are notorious for the materials and energy efficiency of their manufacturing processes. Greater resource efficiency may become a leading component of national economic policy, aligning the interests of pro-business and pro-environmental forces for reduced waste in American manufacturing.<sup>21</sup> Concern about potential legal liability associated with hazardous waste disposal is also leading firms to reduce waste production and re-use intermediate products rather than dispose of them through expensive, tightly controlled processes as hazardous wastes (Tibbs 1991, Oldenburg and Hirschhorn 1987, Plehn and Huisingsh 1985).

Waste reduction is therefore likely to occur even in the absence of explicit policies to encourage it on environmental grounds. Due to the proprietary nature of internal plant operations, however, explicit environmental regulations that mandate technology-specific waste reduction practices are likely to face opposition from most industries. Unlike end-of-the-pipe effluent standards, compliance monitoring for "upstream" process control modifications is very difficult. Because "upstream" management is so poorly suited to the traditional regulatory approaches – where the end-of-the-pipeline application of specific technology was easily monitored by regulatory authorities – incentives-based regulations are likely to play a greater role in promoting waste reduction than traditional command-and-control regulations (see discussion below).

### **The Shift to Life-Cycle Impact Analysis: "Downstream" Responsibility for Product Impacts**

Environmentalists and regulators are also shifting their focus "downstream" from the factory pipe or smokestack to assess the impacts of using a company's products and disposing of them. Environmental organizations are now trying to make consumers more aware of the impact of individual products, while shifting responsibility for higher product disposal costs so those costs will hit consumers directly in the pocketbook. Under consumer pressure, corporations are increasingly recognizing the market value of an environmentally-sensitive reputation.<sup>22</sup> Products designed through environmentally-sensitive methods and recycled materials selection are already appearing as a result (Pardue 1990, Buzzworm 1990, Kirkpatrick 1990).

While this shift appears at first to be simply application of a systems approach to environmental problems, it has important implications that are more subtle. In particular, it redefines the *responsibility* that regulators and consumers will now place on corporations. Meeting emissions standards will no longer be enough: companies will also be held responsible for both the environmental impacts of their *production* processes (e.g., emissions and effluent) and the *consumer* use and disposition of their products (e.g., using recyclable and non-toxic packaging materials). Customers and shareholders may encourage even more "downstream" responsibility through restrictions on the type and amount of packaging or the use of specific materials. This could ultimately lead to a "cradle-to-grave" responsibility for the disposal of products. This has been proposed for car batteries, for example, and some states charge an environmental disposal fee for motor oils.

Global competition may be driving greater efficiency in "upstream" processes, but greater limitations in local landfill capacity – together with the cost of managing hazardous materials in those landfills – appear to be driving the move "downstream" to address the impacts of consumer products. In some cases, those concerns about local landfill capacity and management have led to state policies that compel recycling and source reduction. For example, California's Integrated Waste Management Act of 1989 requires local cities and counties to develop plans for specific reductions of waste streams by 25 percent by 1995 and 50 percent by 2000. Greater use of comprehensive recycling efforts at the local level is a likely result, along with higher dumping fees. Specific packaging materials may also be banned in some areas (e.g., polystyrene in Berkeley, California), while some firms will begin to take direct responsibility for disposal of their products and associated packaging (e.g., the experiment by McDonald's to recycle hamburger containers directly within its franchises (EDF 1991). State and local governments will lead the attack "downstream."

Other materials may be reformulated to improve consumer acceptability, but they may still face opposition from environmentalists (e.g., "photodegradable" or "biodegradable" plastics, which use non-synthetic binding agents). Many environmentalists oppose the shift to reformulated products, because the products may dilute the quality of recycled materials or damage recycling equipment if inadvertently recycled (Pardue 1990). Compulsory use of recycled materials may be required when markets are unable to absorb high levels of recycling. The recent "glut" of recycled newspapers has sent the price to a new low, for example, prompting some cities to dispose of the newspapers in local landfills. California legislators responded by enacting minimum-recycled-content requirements for newsprint (linking "downstream" impacts with the "upstream" production processes).<sup>23</sup>

Recycling and solid waste concerns are not the only areas affected by this new attention on "downstream" impacts. Human exposure to toxics is also related, as the Emissions to Exposures trend (see below) and the Democratization trend highlight new hazards associated with ordinary use of specific consumer products. The manufacturer of "Liquid Paper," for example, was recently compelled to notify consumers of exposure risks under the provisions of Proposition 65, an Initiative passed by California voters in 1986 restricting the release of toxics and requiring warning notices to consumers when such toxics are found in products. The product has now been reformulated for the California market (EDF 1991). Other large industrial producers may also need

to modify their product lines to address "downstream" concerns, including regulation of consumer use of their products. In the Los Angeles air basin, the SCAQMD Air Quality Plan and, nationally, the Federal Clean Air Act could indirectly affect consumer demand for some products, especially those producing ground-level ozone (smog). The California Air Resources Board (1989) has already applied strict regulatory controls to a diffuse set of consumer products. International treaties establish targets for the phase-out of products that generate stratospheric ozone. The U.S., like other countries, has the flexibility to develop its own policies (e.g., a ban on certain manufacturing processes or products) to achieve those targets.

This new focus on "downstream" impacts shifts the emphasis of policy back to corporate responsibility. It links the impacts of consumer product use with new responsibilities on the part of the manufacturers of those products, rather than focusing on the emission contributions of everyday, decentralized sources of pollution through consumer use of products. Environmentalists are also turning to their market power as consumers to achieve changes in the "downstream" environmental impacts of corporate activities. Since even McDonald's is taking responsibility for the waste associated with its products, the trend does not apply only to "industrial" processes. As environmental awareness grows about the impacts of specific products, more firms will be affected. Environmental "labelling" is now common in both Britain and West Germany, for example, with retailers leading the charge "downstream." U.S. retailers are planning to offer similar services, but they have had great difficulty developing a standard measure of the "cradle-to-grave" impacts of products.<sup>24</sup>

### The Shift from Regulating Emissions to Limiting Exposures

Environmental regulations have traditionally focused on specific *emission* limits. A growing concern about the actual human *exposure* to environmental risks is likely to shift that focus, however, leading to greater utilization of "total exposure assessment" (TEA) techniques when establishing priorities and new standards. *Exposures* could displace *emissions* as the focus of policy. The relative risks associated with disposal through different environmental media (e.g., air, water, or land) should play a greater role in regulatory policy and budgetary allocations (Morgenstern and Sessions 1988, Morgenstern et al. 1987, Landy et al. 1990, Graham 1991). However, this trend is partly dependent upon the democratization trend described above, where everyday consumer activities are recognized as important sources of environmental risk. Without such democratization, there will probably be a continuing focus on the emissions and effluent of industrial producers. There would still be selected instances where exposure will be the focus of regulatory policy, but it would not dominate policy-making.<sup>25</sup>

This new emphasis on exposures rather than emissions has already affected public health efforts regarding several non-point sources (e.g., indoor radon, secondary cigarette smoke). According to Smith (1988), human *exposure* to particulates in the U.S. is greater from cigarette smoke than from coal plant *emissions* – despite the significantly greater emissions from coal. This could lead to targeted exposure-oriented policies to limit second-hand cigarette smoke in indoor public areas, for example. Moreover, exposure risks for particular population sub-groups, especially children, may be used more extensively to determine "acceptable" levels of exposure (e.g., lead paint on playground

equipment and pesticide use on apples eaten by children). Finally, regulators in California and at the U.S. EPA have recently turned to relative risk assessment to establish budgetary priorities (Morgenstern and Sessions 1988, U.S. EPA Science Advisory Board 1990, U.S. EPA 1992).

Greater use of these techniques does not represent the sudden embrace of "rational," quantitative risk analysis by the general public. Instead, it indicates both improvements in the technology necessary to acquire good data on total exposures (e.g., portable micro-monitoring equipment) and a desire for rationalization *within the regulatory community*. After a decade of reduced public resources for environmental efforts, "risk analysis" has become a regular part of program planning, budget decisions, and standard-setting. It remains to be seen if the *public* will accept this new emphasis on risk-based standards.

Many environmental groups, especially at the local level, are strongly opposed to many of these efforts. The differential incidence of impacts on specific sub-populations for particular risks (e.g., high levels of risk for a small population at a local Superfund site vs. low overall risks to the U.S. population from Superfund sites across the country) raises important equity issues regarding risk-based assessments. The "NIMBY" syndrome ("Not In My Back Yard") could easily become "NOPE" ("Not On Planet Earth") for some activities or wastes.

The U.S. EPA has found that risk perceptions differ widely between agency experts and the general public (Morgenstern and Sessions 1988, U.S. EPA 1987). This highlights the importance of risk *perception* and the role of non-quantitative factors in assessing people's risk preferences. Communicating risk information and understanding which factors determine public reactions to risks is a complex area (Russell 1986, Allen 1988), requiring careful attention to psychological issues. Nevertheless, rational allocation of public resources requires such an understanding, and TEA techniques may offer information that can improve the efficiency of regulation. It has traditionally been supported by academics and some regulators, and it is now gaining political support from both industry and parts of the environmental community. Both the Environmental Defense Fund and the Natural Resources Defense Council have embraced this approach in specific cases.

This shift to attention on exposures is consistent with a general trend toward greater concern about the toxicity rather than the total discharge of pollutants. Concern about toxic chemicals originally focused on workplace exposures and their appearance in foods for direct human consumption (e.g., mercury poisoning in fish). It then shifted to residential construction sites on abandoned landfills, as Love Canal and Times Beach drove residents away from toxics-contaminated soils. Concern about health impacts focused on vulnerable population sub-groups in those cases, such as children playing in the contaminated soil.

More recently, public anxiety over toxics has focused on the impact of leaking hazardous wastes entering groundwater resources. In many of these cases, however, public concern did not focus on actual human *exposure* to the toxics. Contamination of the groundwater itself (even when human exposure was unlikely) was often deemed an adequate basis for regulatory and legal action, such as those required under Proposition 65 in California (Russell 1989). This runs against the suggested shift from concern about emissions to exposures, and it represents a public demand for "zero risk." The trend from Emissions to

Exposures is therefore a relatively weak one, and it depends primarily on public perceptions and attitudes toward this new approach.

Concern about air toxics and the shift from an emissions orientation to a total-exposure assessment perspective will raise the importance of indoor air quality problems.<sup>26</sup> Radon has already climbed up the list of EPA priorities, and ongoing research regarding natural gas use could take on more importance in the context of utilities' and regulators' strategies for more energy-efficient, super-insulated "tight" homes. This is an example where eliminating the environmental *emissions* associated with one form of energy use (e.g., electricity production) could increase the level of population *exposure* and risk associated with another form of energy (e.g., natural gas) (Smith 1988, Schneider 1986, Taylor 1985).

The increasing complexity of environmental problems requires careful attention to exposure and relative risk in the 1990s. The simpler concern over gross discharges of emissions and effluent was appropriate in the 1970s, when the Great Lakes faced imminent eutrophication and skies were thick with particulates. Those problems have now largely been managed through regulatory controls on industrial *emissions* in the industrialized countries of the West, although they remain serious in many developing countries and eastern Europe. The new challenge for environmental planners is to link environmental policy measures to health risks associated with actual *exposure* to pollutants.

### **The Shift to Incentives-Based Regulation**

The failure of traditional regulatory approaches to resolve environmental problems has led to a more critical evaluation of the efficacy of those policy tools. This failure – together with the other trends described above – is already leading to greater reliance on economic incentives for policy implementation (Stavins 1989). Despite long-standing opposition from most environmental groups, there is growing recognition of the potential value of incentives-based regulations (Krupp 1986). There is also bipartisan Congressional support for such measures (Wirth and Heinz 1988, EPA 1991). The 1990 federal Clean Air Act amendments establish a permit and "trading" mechanism for sulfur oxide emissions that is expected to reduce the cost of compliance by well over a billion dollars (Environmental Defense Fund 1991, Alm 1992, Copeland and Blodgett 1989). The first futures market in emissions permits is also emerging with plans to begin trading of emission offset "futures" on the Chicago Commodity Exchange. Permits have already been traded among large sulfur-oxide emitters in the Midwest. The equity implications (both within and between regions) associated with implementing those provisions have nevertheless led to controversy and debate, and the specific form of and constraints on the incentives can still lead to inefficient implementation. The Congressional debate over the Clean Air Act amendments of 1990 focused on regional cost burdens (Parker 1989).

Technology-based emission standards have failed to resolve many environmental problems. While auto emission tailpipe standards have brought new car emissions down considerably,<sup>27</sup> for example, other factors (e.g., increases in travel frequency and distance) have slowed progress on reducing total auto emissions. Older cars continue to account for a significant fraction of total emissions, and their lives are continually being extended.<sup>28</sup> The efficiency of emission control devices is reduced without regular maintenance and inspection.

tion controls. Increases in both the number of total vehicles and total mileage driven have eaten away at per-vehicle gains.<sup>29</sup> Tightening the tailpipe technical standards has not led to a proportionate decrease in total emissions, because the implicit assumptions of the standards approach have been incorrect. Modifying consumer behavior through economic incentives (e.g., fuel taxes, peak-load toll charges, or emission fees) may therefore be more effective than establishment of even stricter *technology*-based standards.<sup>30</sup>

Economic incentives are not a new idea: resource economists have advocated greater use of market approaches for the past twenty years (Ortolano 1984, Portney 1990, Moore et al. 1989). The techniques were recently applied successfully by the U.S. EPA in the gasoline refinery lead phaseout program, however, and the agency has proposed similar incentives for the CFC production phaseout required under the Montreal Protocol.<sup>31</sup> While initially being applied as the means for achieving established, top-down regulatory objectives, they may eventually become a decentralized alternative to centralized regulation. Policy goals will still need to be set by planners and policymakers, however; this trend merely suggests that the economic implications of those policy goals may carry greater weight.

The economists' theoretical ideal would be to attempt to correct market failures by internalizing environmental externalities into all market prices (Samuelson and Nordhaus 1992). As Herman Daly (1991) and other "ecological economists" have noted, however, the allocative efficiency of markets after internalizing environmental externalities still fails to address the long-term sustainability of the economy in relation to the ecosystem.<sup>32</sup> Moreover, intergenerational equity issues are largely ignored by the internalization process (Howarth and Norgaard 1992). It is therefore still necessary to make difficult policy decisions that address these issues explicitly. It is not enough just to "get the prices right" if the economic activity is unsustainable.

In the case of both the gasoline lead phaseout and the CFC phaseout, the new incentives-based approaches are being applied to meet specific regulatory goals that were based on end-of-the-pipe technical standards. As noted above, however, many of the emerging trends suggest that successful environmental protection policies will no longer be able to rely only on controlling pollution output from a few, centralized "point" sources. Management of upstream and downstream, decentralized and centralized, diffuse and concentrated, point and non-point, stationary and mobile sources requires a variety of approaches. The *transactions costs* associated with managing a command-and-control regulatory system are too great for this broader challenge. Environmental management strategies must therefore increasingly rely on economic incentives to encourage efficient, decentralized behavior by a diverse, ubiquitous range of economic actors to meet policy objectives.<sup>33</sup>

Lessons from the development of alternative energy technologies are relevant here. While tax credit incentives encouraged the *installation* of wind turbines in the early 1980s, they did not necessarily encourage *production*. Revenues from continual operation of the turbines offered the proper incentive, since the policy objective was to encourage greater commercialization of operable technology. Similarly, *technology* standards for auto emissions do not affect the *operational* decisions of drivers – which are the fundamental source of environmental emissions and therefore environmental impacts. Emissions taxes and

similar fees offer economic signals that are in direct relation to the environmental impact of the activity, rather than the *potential* impact. Environmental planners must learn to use these economic tools as well as traditional regulatory tools.

Economic incentives can also be used in resource markets, where institutional constraints may limit the existence and operation of a market. The limited market for water resources is one example. The significant differential between the prices paid for water by agricultural users and municipal users offers an opportunity for economically efficient transactions, with resulting environmental benefits (Bay Area Economic Forum 1991). Recently approved efforts to replace Mono Basin water in California with purchases by Los Angeles from Central Valley farmers could become common practice by the end of the century.<sup>34</sup> The U.S. EPA also advocated greater use of economic incentives and improved water use efficiency for the Denver, Colorado, region when it recently denied approval of construction of the Two Forks Dam. The absence of a water market meant that expensive supply-side resources had been favored over more economic and environmentally benign demand-side options.<sup>35</sup>

Environmental planning in the post-Rio world must include careful assessment of the environmental impacts of infrastructure systems, the economic efficiency of alternative regulatory approaches, and the implementation difficulties (and perverse behavioral incentives) of traditional regulatory policies.<sup>36</sup> Continued reliance on the heavy hand of technology-based, command-and-control regulations will not meet the challenge. Environmental planners must therefore develop the skills to evaluate responses to policies that rely upon more indirect means – such as markets – to achieve environmental policy goals.

### The New Role for the Federal Government and the U.S. EPA

These new problems and management approaches to environmental planning imply both a need for new skills in environmental planning and policy and a new set of roles for environmental planners and environmental institutions. The need for extensive international cooperation (e.g., to address stratospheric ozone depletion or global warming) has already led to the establishment of new institutions, including the Global Environmental Facility and the Commission on Sustainable Development. Both will play a greater role in international environmental policy in the coming decades, and their influence over domestic policy may overshadow the traditional role of the U.S. EPA and the Council on Environmental Quality (CEQ). It is conceivable that *policy-making* authority could shift "up" to a new set of international institutions, leaving the U.S. federal government with more of an *implementation* role for international policy than its current policy-setting and implementation role for federal policy. International institutions would then be the center for policy-making, with implementation delegated to each country. Such a shift would radically change the role of the U.S. EPA. Such a shift is unlikely without considerable loss of sovereignty, however, and the European Community (EC) has seen strong local (national) resistance to similar centralization of powers.

State institutions will also continue to experiment with innovative new policies, sometimes leading the federal government into fertile areas. Recent collaborative action by eight northeastern states to adopt California's auto emission standards compelled a critical compromise on Capitol Hill, for example, by implicitly setting a *de facto* federal standard. The states have taken the lead

on many environmental policy initiatives since the Reagan and Bush administrations left a leadership vacuum in the 1980s. Local governments are also advancing the regulatory boundaries. Irvine, California, has banned CFC use, while Berkeley restricts the use of polystyrene within the city limits. Similarly bold actions will continue in the 1990s. In this way, federal authority over environmental policy will continue to erode as responsibility also shifts "down" from the federal government to state and regional entities. (The Commerce Clause of the U.S. Constitution could lead to federal preemption of state policies, however, in cases where state regulations limit the movement of goods in interstate commerce.) The option of adopting California's regulations under the Federal Clean Air Act could make California the *de facto* federal standard-setter, thus making policy decisions at the SCAQMD critical.

Together with the growing role of international institutions, this trend toward state and regional leadership could leave the federal government with a changed role in environmental policy. Some existing institutions may not be able to adapt to the new policy environment, yet they could stymie innovation by fighting to retain jurisdictional control over critical issues. For example, the Departments of Defense and State have attempted to take the lead on all global environmental negotiations and research, even though they do not take the lead in domestic environmental policy. Non-governmental organizations (NGOs) will also play an increasingly important role in developing countries, which are only now beginning to address the serious environmental degradation affecting their resource use and public health. Building the institutional capacity of those countries to deal with their environmental problems is one of the premiere challenges of the decade. Technical advice and technology transfer will be inadequate; indigenous institutions must also be developed. An estimated 1,500 grassroots organizations in 142 countries participated in Earth Day 1990, and at least that many groups were represented at the Global Forum in Rio during UNCED. Innovations in telecommunications and microcomputing technology now allow thousands of NGOs to "network" around the world to coordinate their lobbying activities and policy initiatives. Many environmental NGOs now communicate regularly through a global computer network, including Econet here in the U.S. The NGOs could become a significant force in environmental policy, defining the policy agenda through both research and advocacy.<sup>37</sup>

At the federal level in the U.S., continuing concern about the lack of progress on environmental problems led to the proposed elevation of the EPA Administrator to Cabinet-level status in 1990. EPA Administrator William K. Reilly went to Rio two years later without this promotion, however, and it is clear that his influence on the U.S. position in negotiations has often been stymied by the Council on Competitiveness and the Domestic Policy Council. Even a new Department of the Environment would continue to face turf battles with other Departments, since those other agencies will increasingly become involved in environmental policy-making. New constituencies may then enter the debate through other federal agencies, as they have with the current institutional structure. Many of these other agencies will therefore need to strengthen their staff expertise on environmental planning and policy. The current political fragmentation of federal decision-making advises against a policy of consolidating all environmental expertise within a single agency like the EPA. Environmental planning and policy are too ubiquitous and important to relegate only to an

advisory or administrative role in the 1990s. Environmental planners need to be part of key decision-making processes in a variety of substantive policy fora.

All environmental planners will need to redefine the scope of their mission in the post-Rio world. A shift from a centralized, command-and-control, end-of-the-pipeline, technology-based regulatory standards approach to a decentralized, incentives-based management system requires new skills and new systems. If traffic management becomes a more effective means for dealing with air quality problems than tailpipe standards, for example, a broader range of technical expertise must be available to implement such programs. Current jurisdictional boundaries and potential turf battles may limit the tools available to environmental agencies, but cooperation will be necessary to solve the problems. Los Angeles has recently attempted to limit truck vehicle traffic during the peak rush hours, for example, but nearby cities must be part of such a plan if it is going to be effective for the entire L.A. basin. The SCAQMD plan is basin-wide, for example, and the agency works closely with the Southern California Association of Governments (SCAG). However, SCAG is only an advisory body, without any power to compel implementation. It is therefore necessary for SCAQMD to structure rules and regulations that create *incentives* for implementation.

The trends discussed in this article will shape the future policy environment for environmental planning, which will then determine the specific form of future environmental planning institutions and policies. This transformation will undoubtedly occur through an incremental process. No grand design exists for "optimal" management of our environmental problems, and the politics of environmental issues ensure that no such design could be implemented "top-down" without either consensus or compromise. Environmental policymakers and participants in the process may also establish new trends that take the debate in new directions, while some of these "emerging" trends may fade to relative unimportance. The pace of change in eastern Europe from 1989-1992 demonstrated how unreliable "safe" predictions can be. The five emerging trends outlined in this article may nevertheless guide us as we tackle the challenges apparent at Rio. Others will certainly emerge in the 1990s.

Unless environmental planners adapt to the new challenges we now face, it is clear that the planning approaches of the past will not solve the global environmental crisis. It is therefore imperative that we adapt both our planning institutions and tools to ensure a legacy for the planet and our own future.

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## NOTES

- <sup>1</sup>The Helsinki Accords were widely criticized in 1975, but their limited references to human rights offered a diplomatic foothold for the United States and other western countries in subsequent negotiations with the Soviet Union. Ultimately, the seemingly ineffectual language of the Helsinki Accords took on symbolic geo-political significance that continues to affect international relations.
- <sup>2</sup>Two Los Angeles gangs, the Crips and the Bloods, recently proposed improvement to the physical environment of south-central Los Angeles in their plan to reconstruct the area following the riots. "Environmental justice" issues are becoming increasingly important in facility siting decisions. See *Race, Poverty and the Environment* (Earth Island Institute).
- <sup>3</sup>U.S. Assistant Secretary of State E.U. Curtis Bohlen coordinated all U.S. Government policy positions for and negotiations in preparation for the UNCED agreements. The U.S. Department of Commerce is guiding the direction of the recently announced U.S.-Asia Environmental Partnership (US-AEP) program, which will funnel aid to developing countries that may then promote the purchase of U.S. exports of environmental technology. The U.S. Department of Defense has recently shifted much of its research effort toward environmental cleanup and restoration.
- <sup>4</sup>It appears that the U.S. is likely to meet this target through fuel-switching and improved energy efficiency, even if it does not make that commitment in an international treaty.
- <sup>5</sup>Note the absence of the words "and Development" in the title.
- <sup>6</sup>The U.S. controls approximately one-fourth of the World Bank's capital, while it receives only one vote in the U.N. General Assembly.
- <sup>7</sup>Named for the Chairwoman of the WCED, Norwegian Prime Minister Gro Harlem Brundtland. She remains the only former Environment Minister in the world to serve as Prime Minister.
- <sup>8</sup>Except for the isolation of the U.S. and Japan during earlier negotiations over the Forestry convention (which broke down long before the "Earth Summit," and therefore did not yield an agreement to be signed), the industrialized countries were remarkably allied. The old Cold War battle between the U.S. and the U.S.S.R. was notably absent, and controversy centered on levels of aid and mechanisms for transferring resources from the industrialized "North" to the developing "South."
- <sup>9</sup>There is now widespread agreement in the scientific community that emissions of "greenhouse gases" have raised levels of those gases in the atmosphere to their highest levels in human history. There is also widespread agreement that higher levels of those gases are likely to result in higher average global temperatures. The only matters now in dispute are: (1) how much "global warming" will occur; (2) at what rate temperatures will change; and (3) what the regional changes in climate will be, given global warming.
- <sup>10</sup>The theory of global climate change as a result of carbon dioxide emissions was actually first postulated late in the 19th century by the Swedish scientist Svante Arrhenius (1859-1927), but it only received widespread international attention a century later.
- <sup>11</sup>Despite this public perception, however, the Commerce clause of the U.S. Constitution continues to limit the ability of states to block the import of wastes from other states. At the same time, U.S. wastes are being exported to Pacific islands.
- <sup>12</sup>Concern about the distribution of environmental benefits and burdens has recently led to a greater investigation of "toxic racism" and "environmental justice," while the issues of the global commons have focused on inter-generational equity issues.
- <sup>13</sup>There were also clear political reasons for this focus, which remain today: consumers vote in elections, while producers are technically non-voting entities (corporations) composed of workers and owned by shareholders who are also voting consumers. Producers may nevertheless have been able to avoid cost-effective regulatory control because they can dominate politics more easily through lobbying activities and PAC influence.
- <sup>14</sup>This approach dominated the federal Clean Air Act (1970) and the federal Clean Water Act (1972), but both were revised by Amendments of 1990 and 1987, respectively.

There are now several non-BACT alternatives available to meet standards (e.g., purchase of offsets or improved efficiency).

<sup>15</sup>See also subsequent letters in *Science* 253 and 255.

<sup>16</sup>These changes have not yet been incorporated into a new Air Quality Management Plan (AQMP), but they were adopted in principle by the SCAQMD Board during review of the 1989 AQMP early in 1992.

<sup>17</sup>The new federal Clean Air Act (1990) allows states to adopt either the federal standards or the more stringent California standards. A coalition of eight northeastern states' environmental commissioners have indicated they will adopt the California rules. The federal standards now place per-capita emission levels for automobiles at about southern California's level 30 years ago.

<sup>18</sup>The San Francisco Bay Area Regional Water Quality Control Board has instituted new rules and an education program designed to reduce such non-point sources, and the federal U.S. EPA has begun to enforce rules under the 1987 Clean Water Act across the country. Among other uses, the rules regulate dispersed agricultural uses.

<sup>19</sup>Paul Portney of Resources for the Future has often emphasized this aspect of regulation (personal communication, April 1992).

<sup>20</sup>Personal communication with staff members in the U.S. EPA Office of Policy, Planning, and Evaluation, 1989-1992.

<sup>21</sup>To some degree, this has already happened in the internal U.S. debate over the global climate change negotiations. Many large U.S. corporations support strict CO<sub>2</sub> reductions that are consistent with energy efficiency investments that will ultimately improve the productivity of industry.

<sup>22</sup>As noted above, however, this may not be a cost-effective marketing strategy in the short run, due to higher production costs. The current recession may also limit its advantages, since consumers may be more cost-conscious than normal.

<sup>23</sup>California State Legislature, *Assembly Bill 1305*, 1989.

<sup>24</sup>There are currently two programs under development in the U.S.: "Green Seal" (a non-profit organization seeking to establish a cradle-to-grave evaluation standard for a range of products) and "Green Cross" (a for-profit corporation that simply verifies manufacturers' advertising claims about their products) (personal communication with Denis Hayes, Chairman of Earth Day 1990 and Green Seal [1990-1992], Palo Alto, California, 1990, and various articles in *Garbage* and *E* magazines from 1990 to 1992).

<sup>25</sup>The San Francisco Bay Area Regional Water Quality Control Board is now developing exposure-based regulatory standards for heavy metals based upon sensitive aquatic species (personal communication, Kim Taylor and Dave Richardson, consultants to BARWQCB, 1991-1992).

<sup>26</sup>Particulate exposure is a critical indoor air quality issue for many developing countries, where biomass fuels are used indoors. Women and children receive the highest exposures.

<sup>27</sup>Average overall emission levels for new automobiles are now estimated to be around 5 percent of 1970 emission levels for new vehicles (for hydrocarbons, carbon monoxide, particulates, and nitrogen oxides). Emission control equipment was only required to remain effective for 50,000 miles, however, under the 1977 Amendments to the Clean Air Act, while most vehicles continued to operate for at least 100,000 miles. California has stricter standards for both emissions and durability of controls.

<sup>28</sup>The Union Oil Company of California (Unocal) offered \$700 per vehicle in 1990 for pre-1971 vehicles in the Los Angeles basin. Tests on a sample of the 8,376 vehicles "retired" under the SCRAP program found that the pre-1971 vehicles emitted roughly three times the hydrocarbon emissions they were expected to (24.8 grams per mile vs. 8.3 grams per mile projected) and nearly one hundred times the emissions of new 1990 cars (0.25 grams per mile).

<sup>29</sup>Vehicle miles travelled (VMT) are estimated to have increased from less than 140 billion VMT in 1975 to nearly 250 billion VMT in 1988, with projected increases to almost 360 billion by 2010. This more than 250 percent increase could overwhelm reductions in emission rates (California Assembly Office of Research 1989).

- <sup>30</sup>Technology-forcing standards are still an important part of regulatory policy, however; California will require that 2 percent of all vehicles sold by any given manufacturer in the state by 1998 be zero-emission vehicles.
- <sup>31</sup>Personal communication, U.S. EPA Staff, 1989 and 1992.
- <sup>32</sup>Much of this current debate appears in *Ecological Economics*, The Journal of the International Society for Ecological Economics (Elsevier). Also note proposals by Tibbs (1991) to restructure economic processes to replicate natural ecological processes.
- <sup>33</sup>Note the importance of transactions costs in establishing institutional arrangements and organizations (Williamson 1979).
- <sup>34</sup>Although it was approved in late 1989, implementation of the agreement has been more difficult than expected due to the drought and uncertainty over the status of the California water system.
- <sup>35</sup>This was also the case with the East Bay Municipal Utility District (EBMUD) of northern California during the late 1980s. A new planning effort has demonstrated that less damaging alternatives exist that are also more economically efficient.
- <sup>36</sup>The differences between setting tax rates for internalization of environmental externalities and regulating emission levels through permits (which are then traded to set a market price for the permits) to achieve specific environmental quality goals are not discussed here, but either approach requires some explicit policy objective that reflects the value of reducing emissions. Economic analysis is therefore necessary for either to determine the proper relationship between price and quantity.
- <sup>37</sup>Forty-five NGOs from twenty-one different countries recently announced at the Rio Global Forum their intent to cooperate on global issues through EarthAction International, a new "umbrella" organization based in Brussels, Belgium. Partner organizations in the U.S. include the Sierra Club and Friends of the Earth.

## REFERENCES

- Allen, F. W. 1988. "Differing Views of Risk: The Challenge for Decisionmakers in a Democracy." Unpublished manuscript, U.S. EPA Office of Policy, Planning, and Evaluation.
- Alm, A. L. 1992. "A Need for New Approaches: Command-and-control is no longer a cure-all." *EPA Journal* 18(2), May/June: 7-11.
- Andrews, R. N. L. 1992. "Environmental Policy-Making in the United States." Unpublished manuscript, prepared for the European Institute, Washington, D.C., January 9-10.
- Bay Area Economic Forum. *Using Water Better: A Market-Based Approach to California's Water Crisis*. San Francisco (October).
- Benedick, R. E. 1991. *Ozone Diplomacy: New Directions in Safeguarding the Planet*. Cambridge, Massachusetts: Harvard University Press.
- Buzzworm: *The Environmental Journal*. 1990. "The 1990 Directory to Green Products." II(1), January/February.
- Caldwell, L. K. 1985. "Cooperation and Conflict: International Response to Environmental Issues." *Environment* 27(1), January/February.
- California Air Resources Board. 1989. *Consumer Products Control Plan*. Sacramento, California (June 16).
- California Assembly Office of Research. 1989. *California 2000: Exhausting Clean Air: Major Issues in Managing Air Quality*. Sacramento, California (October).
- Clark, W. C. 1989. "Managing Planet Earth." *Scientific American* 261(3), September.
- Clark, W. C., and R. E. Munn, eds. 1986. *Sustainable Development of the Biosphere*. International Institute for Applied Systems Analysis, Laxenburg, Austria. New York: Cambridge University Press.
- Copeland, C., and J. E. Blodgett. 1989. *Clean Air Amendments: Permits and Market-Oriented Provisions in the Administration Bill*. Congressional Research Service, CRS Report to Congress #89-486 ENR (August 18).

## Berkeley Planning Journal

- Daly, H. 1991. *Steady-State Economics*. Second Edition with additional essays. Washington, D.C.: Island Press.
- Dunlap, R. E. 1987. "Public Opinion on the Environment in the Reagan Era." *Environment* 29(6), July/August.
- . 1985. "Public Opinion: Behind the Transformation." *EPA Journal* 11(6), July/August: 15-17.
- Earth Island Institute. 1990-1992. *Race, Poverty and the Environment*. San Francisco, California: Earth Island Institute.
- Environmental Defense Fund (EDF). 1991. *Letter and Annual Report*.
- French, H. F. 1988. "Industrial Wasteland." *Worldwatch* 1(6), November/December.
- Gore, A. 1992. *Earth in the Balance: Ecology and the Human Spirit*. Boston: Houghton Mifflin.
- Graedel, T. E. 1989. "Regional and Global Impacts on the Biosphere." *Environment* 31(1), January/February.
- Graham, J. D., ed. 1991. *Harnessing Science for Environmental Regulation*. New York: Praeger.
- Hair, J. D. 1989. "Changing from 'Consumers' to Citizens." *EPA Journal* 15(4), July/August: 37-39.
- Hill, G. 1989. "A Management Job for the Human Race." *EPA Journal* 15(4), July/August: 2-7.
- Hoffman, J. S., J. B. Wells, and S. R. Seidel. 1986. "The Science of Global Pollution." *EPA Journal* 12(10), December: 24-25.
- Howarth, R. B., and R. B. Norgaard. 1992. "Environmental Valuation Under Sustainable Development." *American Economic Review* 80(2), May: 473-77.
- Innes, J. E. 1990. *Knowledge and Public Policy: The Search for Meaningful Indicators*. Second Edition. New Brunswick, New Jersey: Transaction Publishers.
- Jacobson, J. L. 1989. "Abandoning Homelands." In *State of the World 1989*, L. Brown et al., eds., New York: W. W. Norton.
- Kirkpatrick, D. 1990. "Environmentalism: The New Crusade." *Fortune*, February 12.
- Krupnick, A. J., and P. R. Portney. 1991. "Controlling Urban Air Pollution: A Benefit-Cost Assessment." *Science* 252: 522-28 (April 26).
- Krupp, F. D. 1986. "Viewpoint: New Thinking in American Environmentalism." *EPA Journal* 12(10), December: 26.
- Landy, M. K., M. J. Roberts, and S. R. Thomas. 1990. *The Environmental Protection Agency: Asking the Wrong Questions*. New York: Oxford University Press.
- Masters, G. M. 1974. *Introduction to Environmental Science and Technology*. New York: John Wiley and Sons.
- Mathews, J. T. 1989a. "Redefining Security." *Foreign Affairs* 69(2), Spring.
- . 1989b. "Tackling the Institutional Barriers." *EPA Journal* 15(4), July/August: 12-14.
- Moore, J. L., L. Parker, J. E. Blodgett, J. E. McCarthy, and D. E. Gushee. 1989. *Using Incentives for Environmental Protection: An Overview*. Congressional Research Service, CRS Report to Congress #89-360 ENR (June 2).
- Morgenstern, R. D., and S. Sessions. 1988. "EPA's Unfinished Business: Weighing Environmental Risks." *Environment* 30(6), July/August.
- Morgenstern, R. D., P. T. Cummings, W. A. Butler, and K. L. Hall. 1987. "Unfinished Business in Protecting the Environment: A Forum." *EPA Journal* 13(4), May: 44-47.
- Myers, N. 1987. *Not Far Afield: U.S. Interests and the Global Environment*. Washington, D.C.: World Resources Institute (June).
- Oldenburg, K. U., and J. S. Hirschhorn. 1987. "Waste Reduction: A New Strategy to Avoid Pollution." *Environment* 29(2), March.
- Ortolano, L. 1984. *Environmental Planning and Decision Making*. New York: John Wiley and Sons.
- Pardue, L. 1990. "Biodegradable Plastics: A Contradiction in Terms?" *E Magazine* 1(1), January/February.

- Petulla, J. M. 1987. *Environmental Protection in the United States: Industry/Agencies/Environmentalists*. San Francisco: San Francisco Study Center.
- Parker, L. 1989. *Distributing the Cost of Acid Rain Control: Cost-Sharing Under a Freedom-of-Choice Proposal*. Congressional Research Service, CRS Report to Congress #89-536 ENR (September 21).
- Perry, J. S. 1986. "Managing the World Environment." *Environment* 28(1), January/February.
- Plehn, S. W., and D. Huisingh. 1985. "Strong Incentives for Industrial Recycling." *EPA Journal* 22(6), July/August: 10-11.
- Portney, P. R., ed. 1990. *Public Policies for Environmental Protection*. Washington, D.C.: Resources for the Future.
- Ruckelshaus, W. D. 1989. "Toward a Sustainable World." *Scientific American* 261(3), September.
- Rosenbaum, W. A. 1977. *The Politics of Environmental Concern*. Second Edition. New York: Praeger.
- Russell, C. 1989. "Forewarned is Fairly Warned." *Sierra* 74(6), November/December.
- Russell, M. 1986. "Communicating Risk to a Concerned Public." *EPA Journal*, November.
- Samuelson, P. A., and W. D. Nordhaus. 1992. *Economics*, 14th Edition. New York: McGraw-Hill.
- Schneider, C. 1986. "The Indoor Air Burden." *EPA Journal* 12(6), August: 14-15.
- Schneider, S. H. 1989. "The Greenhouse Effect: Science and Policy." *Science* 243(4892): 771-81, February 10.
- Smith, K. 1988. "Air Pollution: Assessing Total Exposure in the United States." *Environment* 30(8), October.
- South Coast Air Quality Management District and Southern California Association of Governments. 1989. *Final 1989 Air Quality Management Plan*. March (approved March 17, 1989).
- Stavins, R. N. 1989. "Harnessing Market Forces to Protect the Environment." *Environment* 31(1), January/February.
- Taylor, R. A. 1985. "A Growing Concern with Indoor Air." *EPA Journal* 11(10), December: 18-19.
- Tibbs, H. 1991. *Industrial Ecology: An Environmental Agenda for Industry*. Boston, Massachusetts: Arthur D. Little, Inc.
- U.S. Environmental Protection Agency. 1987. *Unfinished Business: A Comparative Assessment of Environmental Problems*. Office of Policy, Planning and Evaluation (February).
- \_\_\_\_\_. 1991. *Economic Incentives: Options for Environmental Protection*. EPA #21-2001 (March).
- \_\_\_\_\_. 1992. *Safeguarding the Future: Credible Science, Credible Decisions*. EPA/600/9-91-050 (March).
- U.S. Environmental Protection Agency, Science Advisory Board. 1990. *Reducing Risk: Setting Priorities and Strategies for Environmental Protection*. SAB-EC-90-021 (September).
- Usher, P. 1989. "World Conference on the Changing Atmosphere: Implications for Global Security." *Environment* 31(1), January/February.
- Wald, M. L. 1989. *New York Times*, various articles, October.
- Wirth, T., and J. Heinz (R. N. Stavins, ed.) 1988. *Harnessing Market Forces to Protect Our Environment: Initiatives for the New President*. Project 88 Final Report (December).
- World Commission on Environment and Development. 1987. *Our Common Future*. New York: Oxford University Press.