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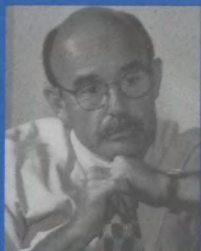
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## Learning by Looking

### Here and Now, Forward and Back



Paul R. Portney

While the "climate summit" in Kyoto was surely 1997's biggest environmental story, it raised at least as many questions as it answered. Looking forward, this issue of *Resources* begins with an identification of outstanding issues. And looking backward—as befits the turning of a new year—my colleagues also review the origins at RFF of another idea that is *au courant* today.

For some time now, several of RFF's analysts have been sorting through the myriad socioeconomic and political puzzle pieces that have to fit together before the world's governments can develop a workable response to the prospect of human-induced climate change. Here Ray Kopp, Dick Morgenstern, and Mike Toman pool their thoughts on what did and did not get accomplished at the Kyoto meeting in December. They opine on what the administration needs to do before the Senate is likely to ratify the U.S. commitment to carbon emissions reductions, and how to prepare for the next round of talks in Buenos Aires later this year.

In her feature on the ways that special interest groups shape the process of protecting vulnerable plants and animals, Amy Ando looks at the Endangered Species Act in its current form and the implications of changes Congress might make in 1998.

Looking back more than thirty years, Allen Kneese tells how RFF nurtured the seeds of "industrial ecology" and Jesse Ausubel recounts how this concept has recently moved beyond academia into corporate boardrooms.

As for the government's future role in environmental management, Wally Oates suggests taking a closer look at "facts on the ground" before rejecting local approaches in favor of federalism.

Terry Davies tells us about a major assessment of the current status of U.S. pollution control. The findings from his new book are just out and they intersect with and amplify some of what Oates and Ausubel have to say.

Year-end is a time to recognize our "family" connections and the satisfaction and pleasure they kindle. The people at RFF have created a generous, supportive, and friendly atmosphere in which we are fortunate to work. To give readers a chance to get to know us better, *Resources* is running an occasional series of interviews with researchers. First up you'll find a profile of Senior Fellow Alan Krupnick.

As we enter 1998, we deeply appreciate all of you who support our work. RFF's diverse sources of support strengthen our ability to exercise the independent judgment that may be our most valuable contribution. To those of you listed here as donors, we extend our special thanks and best wishes. We are committed to continue work that merits your support in the years ahead.

Paul Portney



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## GOINGS ON

### Green Russians address red mess

When officials from the Center for Russian Environmental Policy were in Washington this fall they stopped by RFF to discuss the legacy of environmental problems inherited from the former Soviet Union. These visitors were Alexey V. Yablokov, who chairs the center, and Vladimir M. Zakharov, his deputy. An expert on marine mammals, Yablokov is probably Russia's best known environmental leader and the former chairman of the Interagency Commission on Environmental Security of Russia's National Security Council. In this latter capacity, he served as an adviser to Boris Yeltsin.

Founded in 1993, the center is beginning to identify Russia's most pressing air and water quality problems. Stakeholder participation and high-level environmental training will be part of the approach to establishing national environmental priorities.

After an initial meeting with both directors of the center and then a subsequent one with Zakharov, RFF Visiting Scholar Ruth Greenspan Bell said that she and Fellow Kris Wernstedt are hopeful that the two institutions can work more closely to build on what each has done to assist environmental protection efforts in Russia. Both she and Wernstedt have worked before with former Soviet Bloc countries on environmental problems resulting from years of neglect. ☞

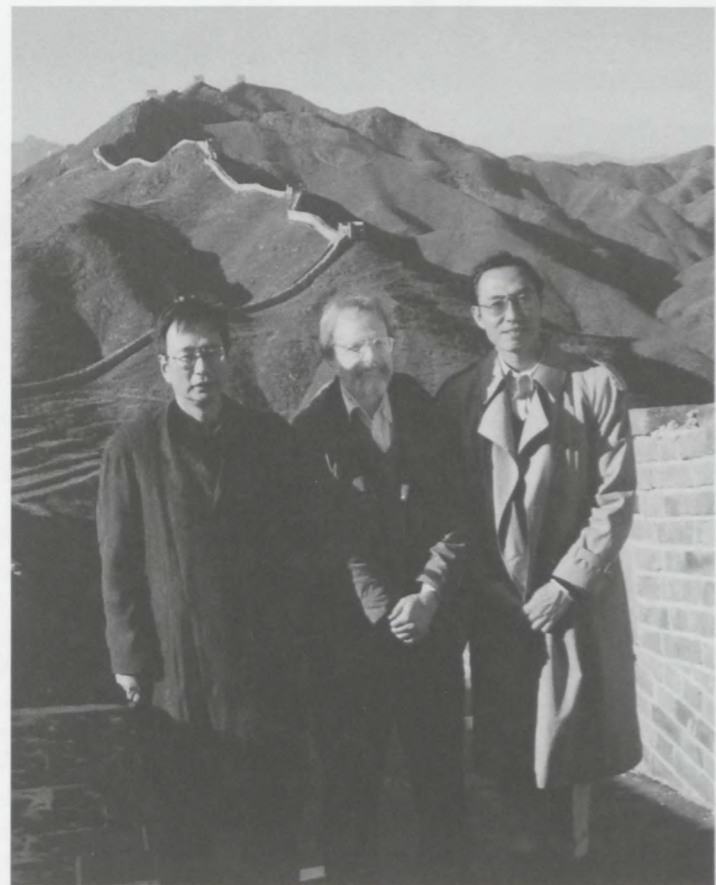
### China hosts climate dialogue

*A workshop held in Beijing this past fall gave researchers from China, Japan, and the United States an opportunity to exchange ideas on practical strategies for enhancing international cooperation on greenhouse gas mitigation and sustainable development. Michael A. Toman, who directs RFF's Division of Energy and Natural Resources, reports on the event below.*

International cooperation is crucial to the success of any plan to curb the emissions of heat-trapping greenhouse gases, most analysts agree. Among the broad approaches for improved international cooperation are various efforts that would improve the international transfer and diffusion of "climate-friendlier" technology for reducing baseline emissions in developed and developing countries alike—notably, policy reforms to strengthen market mechanisms and economic incentives.

These were the broad themes of a workshop held in Beijing November 14–17 that brought together research teams from RFF, the Beijing Environment and Development Institute (an independent research organization that RFF helped to found in 1995), and the Central Research Institute of Electric Power Industry in Tokyo.

Among the conclusions that workshop participants drew was that China's significant progress toward a more mar-



*On the Simatai section of the Great Wall (left to right): Yoshitaka Niita, director of R&D at Japan's Central Research Institute of Electric Power Industry; RFF's Michael A. Toman; and Ma Zhong, president of the Beijing Environment and Development Institute.*

ket-oriented economy will help improve energy efficiency, thereby reducing greenhouse gas emissions as well as providing local benefits. Participants also agreed that a number of technical and economic options exist for pursuing such multiple benefits, and that encouragement of economic incentives is key to their attainment. Finally, there was general agreement that China continues to change rapidly, and that it is important for decisionmakers elsewhere to have a clear understanding of

China's current circumstances.

The workshop included a seminar in which the three research teams had a valuable opportunity to discuss their findings with some of China's most senior leaders in government, industry, and academia. Both the workshop and seminar had an atmosphere of unusual energy and openness.

RFF's climate change website ([www.weathervane.rff.org](http://www.weathervane.rff.org)) offers a summary of the workshop and a link to download selected workshop papers. ☞



# Climate Change Policy After Kyoto

by Raymond J. Kopp, Richard D. Morgenstern, and Michael A. Toman

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The Kyoto climate agreement signals a new level of international attention to limiting “greenhouse gas” emissions. But many important issues remain to be resolved before ratification by the U.S. Senate and implementation.

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**O**n December 10, 1997, 160 nations reached agreement in Kyoto, Japan on limiting emissions of carbon dioxide and other “greenhouse gases.” The Kyoto Protocol is a significant victory for advocates who have sought to convince world leaders to address climate change. It is intended to signal to governments, businesses, and households that limits will be placed on future emissions of greenhouse gases, and that now is the time to begin developing the necessary technologies. Advocates also express the hope that acceptance by industrialized countries of binding emissions limits would make developing countries more willing to take emissions-limiting actions appropriate to their own circumstances.

As we discuss in the balance of the article, however, the protocol itself has significant gaps; the costs of meeting the stipulated targets are not tremendous but not trivial either; and there is still a great deal to settle with respect to the domestic policy agenda.

A protocol that is both workable in practice and capable of being ratified by the Senate must come to grips with three basic questions. First, does it represent a sound framework for attaining long-term global emissions-reduction goals, and is it clear enough to serve as a sort of international contract to which parties can commit?

Second, how costly are the targets and timetables for greenhouse gas reduction agreed to by the United States and other Annex I countries—are they as affordable as the administration says, or as burdensome as the fossil fuel industry has asserted? Third, what measures would the United States deploy in order to achieve the goals laid out in the protocol?

## Refining the Protocol

The negotiators deferred action on several important but controversial elements to a subsequent meeting scheduled for Buenos Aires in the fall of 1998. President Clinton has indicated that he will not send the protocol to the U.S. Senate for ratification until more progress is made on these issues. We believe that, at a minimum, the following must be accomplished before ratification and implementation can occur.

*The rules and institutions that will govern international trading of greenhouse gas emissions among Annex I countries must be better established.* Article 6 of the protocol provides for emissions trading, but only in the vaguest of terms. How the trading program is carried out will greatly affect the capacity to hold down compliance costs. A program that establishes a freely functioning, largely private market in emissions permits, where private entities may execute trades with minimal bureaucratic red tape, will be the most efficient and will lead to the greatest cost savings. In contrast, a market permitting only trades by governments, or a market where private trades are hamstrung by overly restrictive rules, will sap the cost savings.

*The rules and institutions governing joint implementation (the so-called Clean Development Mechanism) must be developed in detail.* Under Article 12, Annex I countries can jointly undertake projects with developing countries to reduce emissions in the latter countries and count those reductions toward compliance with their own commitments where it is possible to establish meaningful baselines against which reductions can be measured.

Again, however, the protocol does not address how such projects can be undertaken. A well-supervised but freely functioning market combined with credible

certification and enforcement of reductions would yield real greenhouse gas reductions at lower cost. An overly restrictive and bureaucratic system would sap possible gains.

***The criteria used to judge compliance, and any penalties for noncompliance, must be clearly articulated.*** The protocol contains a number of technical provisions for assessing national performance in measuring emissions and meeting emissions control objectives. These provisions build on previous efforts under the United Nations Framework Convention on Climate Change but are complicated by the more comprehensive nature of the new protocol. Beyond these technical questions, the fundamental issue is what actions, if any, would be taken if a country were found not to be in compliance. The emissions goals of Annex I countries are taken to be binding under international law, but the protocol itself contains no stipulations for sanctions in the event of noncompliance.

***A binding agreement on the part of the major developing countries to limit their emissions at some specified point in the future must be obtained.*** The Framework Convention clearly states that developing countries do not bear the same obligations as developed nations for emissions control in the short term. Nevertheless, the protocol could and should contain commitments from developing countries to limit their emissions *growth*. Developing countries could achieve such limits through “no regrets” measures that would be prudent to take in any case and through agreements to eventually cap emissions as their economic circumstances improve in exchange for assistance in adopting clean technologies.

The lack of any early commitment by developing countries not only aggravates short-term concerns in the United States and other industrial countries about international competitiveness but also raises the specter of developing countries’ becoming “locked in” to more fossil-fuel-intensive technologies.

***To make longer-term objectives more credible, moderate but specific near-term goals should be set for Annex I countries and these countries should be able to use early emissions reductions to meet longer-term requirements.*** Other than a passing reference in Article 3 to the need for “demonstrable progress” in achieving commitments by 2005, the protocol is silent on interim measures. Yet without interim targets, prospects for achieving more ambitious longer-term goals become problematic and the incentives to engage in long-term investments in new capital and

## The Kyoto Protocol

The Kyoto Protocol calls for the industrialized nations—the so-called Annex I countries—to reduce their average national emissions over the period 2008–2012 to about 5 percent below 1990 levels. The United States pledge is 7 percent below the 1990 level, slightly less than the European Union’s pledge and slightly more than Japan’s. None of the developing countries is required to set any limits.

The protocol includes all the major greenhouse gases and takes into account changes in emissions resulting from changes in forest and land use patterns. The protocol also contains the elements of a program for international trading of greenhouse gas emissions. Such trading would employ market incentives to help ensure that the lowest-cost opportunities for reductions are pursued.

technology are undercut. Incentives for cost-effective reductions before 2008 to meet long-term requirements also are limited since the protocol makes no provision for emitters to “bank” such reductions.

### Implementing the Protocol

In the runup to Kyoto, a number of experts pointed out that both the environment and the economy might be served by following a slower path to emissions control than the protocol stipulates while developing the technologies for more aggressive and affordable emissions reductions later. Others disputed this view. In any event, the agreement reached in Kyoto sets the stage for discussion and for future debate in the Senate.

Some have claimed that meeting the protocol’s targets ultimately will be inexpensive or even free because there is a large untapped reservoir of cheap energy-efficiency opportunities available today and new technologies will materialize in the near future. Others predict economic collapse.

In our judgment, neither extreme view is correct. The likelihood is substantial, however, that the proposed target and timetable will impose significant costs on the United States and the global economy, even after accounting for new technology stimulated by domestic policies. The limit agreed to by the United States implies a reduction of about one-third compared with what the U.S. Department of Energy estimates carbon dioxide emissions will be by the end of the next decade.

Even with the flexibility to reduce emissions of other gases, achieving emissions reductions of such

magnitudes in fifteen years at most will lead to higher energy prices and thus costs that will be borne throughout the economy.

These costs in turn will give rise to serious debates about fairness. Recent public opinion polling indicates increased concern about climate change and some willingness to shoulder burdens to curb greenhouse gas emissions, but there is no compelling evidence that the public is ready to accept significant increases in energy prices or other costs. In light of these costs, it is an open question whether the Senate is willing to ratify the target and timetable stipulated in the protocol.

An important first step in fostering a productive debate nationally and in the Senate over the protocol is better understanding of its benefits and costs. Advocates should dispense with the pretense that emissions reductions of the scale and speed proposed can be achieved at negligible or even negative cost, or that reductions necessarily doom the economy. To shine a brighter light on the costs and consequences of the protocol requires an investment in better and more inclusive analysis and review of estimates, so that competing claims can be adjudicated and new ideas introduced.

Even after questions about the protocol itself are settled, domestic policy options for achieving the targets and timetables require more thorough consideration. The United States deserves credit for advancing some specific measures. Still, the proposal the administration offered in October—\$5 billion in incentives for new technology—will not be enough to move the economy from where it is today to where it needs to be to meet the Kyoto goals.

Ultimately, if the United States is to even approach the Kyoto goals, energy prices must rise enough—especially for coal, the most carbon-rich fossil fuel—to induce enough conservation, energy efficiency, fuel switching, and development and deployment of new technologies and energy forms. How large this price rise will have to be depends on what domestic policies are used. No agreement yet exists on this policy menu. Even if an efficient mechanism like emissions trading is used within the United States, important questions of who gains and loses from the policy remain to be settled.

To cut U.S. emissions as cost-effectively as possible, Congress and the administration should commit to the use of incentive-based policies for emissions control. Well-intentioned but costly proposals to

mandate energy efficiency through rigid command-and-control measures must be avoided. In addition, policies aimed at encouraging the development and dissemination of low-emissions technology need careful scrutiny to avoid waste (for example, through an ill-focused subsidy policy).

The institution of some modest interim measures to limit greenhouse gases is important for establishing the credibility of longer-term reduction goals. A domestic emissions trading program with looser controls than the protocol requires is one example. Such a program could be combined with a “safety valve” to cap the price of a tradable emissions permit at some prespecified level that would rise over time, with the government offering additional emissions permits as needed to maintain the price caps.

Such an approach would complement the policies the administration already has announced and provide valuable information about how emissions control policies work, as well as their costs to the economy. It also would offer such near-term benefits as improved air quality from reduced conventional air pollutants and encouragement for the development of lower-emissions technologies. Even stronger incentives for early demonstrable progress would be provided if any early emissions reductions below an established baseline (for example, actual 1997 emissions levels) could be banked to meet subsequent constraints.

### **Necessary Actions**

To enhance the prospects for an effective climate policy, U.S. negotiators at Buenos Aires must take the lead in establishing the basis for well-functioning emissions trading and joint implementation. They must also take the lead in developing an approach for truly meaningful participation by developing countries. To enhance the credibility of the longer-term goals in the protocol, the United States needs to work to establish cost-effective and affordable interim measures. These initiatives need to be combined with a renewed effort to better gauge the costs and benefits of the protocol obligations and a search for effective and innovative domestic policy tools. Last but not least, the American public needs to better engage in debating this complex, long-term issue.

Raymond J. Kopp directs RFF's Quality of the Environment Division, where Richard D. Morgenstern is a visiting scholar on leave from the U.S. Environmental Protection Agency. Michael A. Toman directs RFF's Energy and Natural Resources Division.



# Ecosystems, Interest Groups, and the Endangered Species Act

by Amy W. Ando

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How science is used to design habitat protection plans may determine the success of a more "multispecies" approach to wildlife conservation. Research shows that the public is likely to influence development of such plans—which may be beneficial as long as competing interests have equal voices.

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The Endangered Species Act stands as the most ambitious piece of species-protection legislation ever enacted by a single nation. It is also highly controversial, pitting conservation advocates against those who own or use the land and water on which rare species depend for their survival. Passed in 1973, the act's authorization expired at the end of fiscal year 1992. Since then, Congress has entertained many reauthorization bills, but none has managed to pass both houses and be signed into law. Instead, the act has had to limp along at the mercy of appropriations committees for its budget and on the occasional court decision for its refinements.

Conservationists argue that the act has many weaknesses and, in particular, that the status quo provides inadequate protection for the vast majority of endangered species on private property. They view a strengthened act as urgently needed. The impasse over reenactment, they believe, imperils species that are not making progress toward recovery even when they are

protected under the law as "threatened" or "endangered." On the other hand, those who stand to incur costs are concerned about the impact of species protection on private property. If there is to be any reincarnation of the act, they want assurances that it will do more than the current law to take into account the costs of the limits the act has put on the way they use their land.

When Congress recessed late this past fall, it left behind some evidence that its members are working not only to end the five-year hiatus but to break the impasse over how the act should be crafted in the future. The Senate Environment and Public Works Committee passed a reauthorization bill, S.R. 1180, while the House considered an analogous piece of legislation, H.R. 2351, which did not make it out of committee.

These bills do not appeal to the same coalitions in the endangered-species political arena. For reasons not within the scope of this article, the House

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bill is favored by environmental groups, while the Senate bill has greater support from developers and industry. They are not, however, completely different. Among other things, both bills contain elements of a "multispecies" approach to protection and recovery.

In this way, the Senate and (to a lesser extent) the House bill reflect a growing perception that it makes more sense to think of species as parts of ecosystems rather than as isolated entities. Indeed, the existing processes of designating critical habitat and designing recovery plans for threatened or endangered wildlife often have evolved into multispecies processes, acknowledging the overlap and interdependencies among species that share habitat. The multispecies approach to conservation has received much recent attention, due in part to the large-scale habitat conservation plans currently being developed and executed in many parts of the country. These plans seek to accommodate both conservation and development interests on private land, despite the fact that the current law has no real guidelines for how to design and assess such plans.

### Economies of Scale

How does a multispecies approach compare with a species-by-species approach in the process of identifying and listing vertebrates, invertebrates, and plants that are in danger of becoming extinct? Research implies that there may be economies of scale in species protection—it may cost less to protect a number of species together in naturally-occurring groups than to protect the same number of species as scattered, disjoint entities.

I have conducted analyses of the time that passes between the proposed and final addition of species to the list of those that are protected under the act. Species are sometimes proposed in groups, often because they come from similar ecosystems and regions. My analyses indicate that such multispecies packages take no longer to be listed than single species; administrative economies of scale appear to exist to processing them as a group. This advantage is of some significance, given the limits on the budgets of the Fish and Wildlife Service and National Marine Fisheries Service, the two agencies that administer the act.

Second, an analysis of interest-group pressure in response to listing proposals shows that multispecies proposals have attracted no more or less opposition than single-species proposals. This implies that physical economies of scale exist in terms of the cost to society of species protection. Furthermore, proposals in regions with a high density of previously listed species per acre tend to attract relatively less support. This response may occur because protecting one species in a given area extends protection to its neighbors, or because some groups care about preserving the underlying habitat rather than the particular species that live on it.

Third, analysis of the geographic distribution of endangered species in the United States conducted by other researchers has revealed substantial areas of overlapping ranges, highlighting the potential for economies of scale in protecting species in those areas.

Yet some risks may be involved in the multispecies approach, too. The current Endangered Species Act has, for all its flaws, been a safety net for each individual threatened species. Some conservation advocates worry that in the shift toward multispecies conservation plans, individual species may fall through the net. For example, habitat protection requirements based on scientific knowledge of the needs of a few high-profile "indicator



species" may not be adequate to protect other less well-known species that inhabit the same region.

In addition, the bills before the House and Senate have different provisions for public participation in the processes of developing conservation plans. Conservation advocates worry that the provisions currently found in the Senate bill will allow industry and developers to skew the use of science in the development of habitat conservation plans away from the interests of species and those who would protect them.

### Impact of the Public

Will public participation have the effect critics worry it will? If history serves as any guide, interest groups on both sides of the issue have the potential to influence the formation of conservation plans. Analyses that I have conducted of proposals to add species to the endangered species list show that public comments during the listing process inject considerations of costs and benefits even where the law expressly prohibits them (see *Resources* 128, Summer 1997).

Using data on nonmarine species that were in the listing process from 1989 to 1994, I analyzed the factors that influence how long it takes a given species to progress through relatively advanced stages of the process. That study looks at the time it takes a species to be officially listed once the Fish and Wildlife Service has placed a proposal in the *Federal Register* to list it. It also analyzes the delay that species experience while they wait to be proposed. This pre-proposal stage is called "Category 1," and contains species that the service feels certain it can propose for inclusion on the list as soon as resources become available.

The analyses that I conducted show that interest groups play a sizable role in how long species take to be placed on the list. Species that enter the process through a petition, which carries with it support from the petitioner as well as scientific evidence to help the agency prepare the case, spend fourteen fewer months in Category 1 than do species that enter the process from within the agency. Once species have been proposed, hearing requests from opponents add six weeks (a 12 percent addition) to the proposal period, and opposing comments can add over thirteen weeks (a 26 percent addition) to the wait. On the other hand, supporting comments can reduce the delay by even more.

Delay postpones the costs (species and their habitats are not protected until a listing is final) and reduces the benefits (the population may decline, making ultimate recovery more difficult) of a given listing. Thus, these results imply that interest groups can influence at least one aspect of agency behavior that has real welfare effects—both for species and for stakeholders.

A separate analysis of the determinants of the intensity of interest-group pressure reveals that these groups respond to circumstances rather than purely to ideology; support is stronger for listings that have higher perceived benefits, and opposition is heightened when the potential costs are large because much land will be subject to new restrictions on use. Of course, the public comment process is not equivalent to that of a pure cost-benefit analysis. Pressure from both sides may still be affected by factors such as political ideology. Nonetheless, interest-group pressure from petitions, hearings, and comments prevents the listing process from being devoid of economic balance.

So, yes, based on empirical evidence to date, it does seem that public participation will shape the processes that design multispecies conservation plans and influence the balances of the final outcomes between competing interests. However, as long as the law includes something like the House provision that economic and conservation interests must be given equal access to the process, that balance may not be a bad thing. The benefits of exploiting the economies of scale in species conservation may be large enough to warrant codification of the multispecies approach in the reauthorized Endangered Species Act, despite the risks.

Amy W. Ando is a Fellow in the Quality of the Environment Division of RFF.

### Further Reading

Ando, Amy W. "Delay on the Path to the Endangered Species List: Do Costs and Benefits Matter?" RFF Discussion Paper 97-43.

Ando, Amy W. "Interest-Group Behavior and the Endangered Species Act," RFF Discussion Paper 97-44.

Dobson, A. P., J. P. Rodriguez, W. M. Roberts, D. S. Wilcove. "Geographic Distribution of Endangered Species in the United States," *Science* 275 (1/24/97): 550-553.



# Industrial Ecology and "Getting the Prices Right"

by *Allen V. Kneese*

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Industrial ecologists are employing innovative technologies and other inducements to curb environmental degradation. Fixing the markets could accelerate—and simplify—progress toward their goal.

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**D**uring the 1990s, the term "industrial ecology" has emerged from academia into corporate and public policy. The term reflects a conviction that modern industrial activity must account for its environmental impacts (see Jesse Ausubel's story on page 14). Some nations and firms are paying serious attention to the ultimate goal of industrial ecology, which is to minimize harmful wastes and to use and reuse to the greatest extent both industrial products themselves and their wastes. As yet, though, such interest is very isolated.

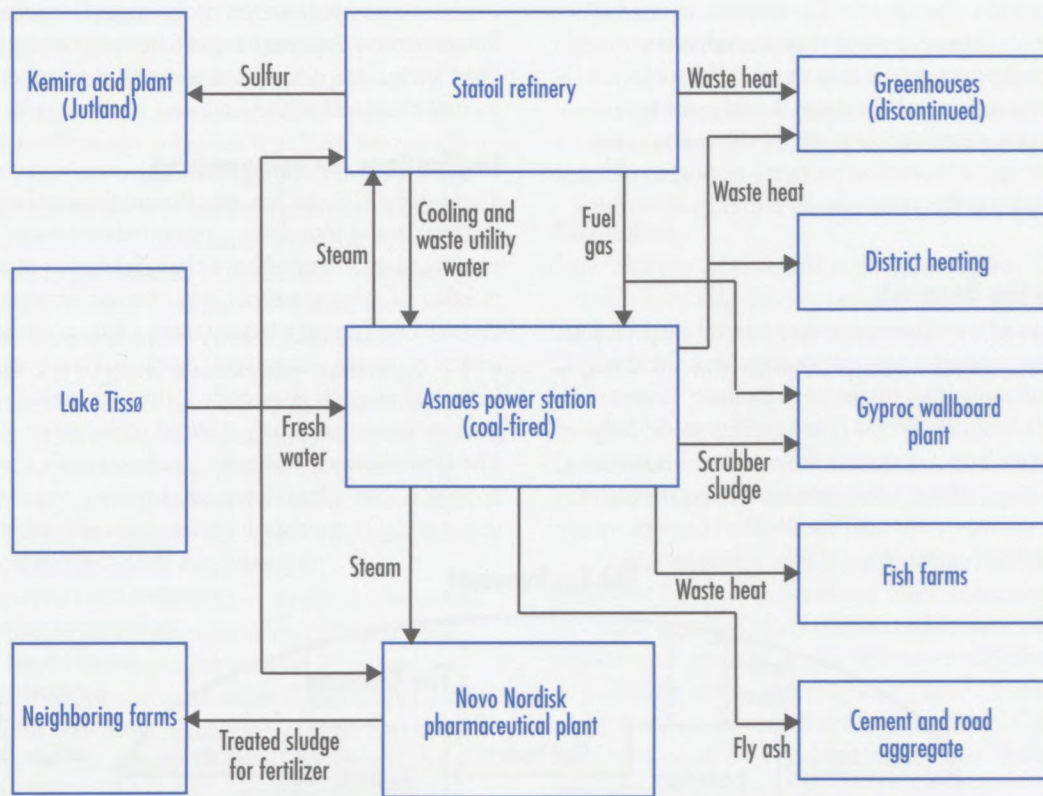
Why is interest not more widespread in achieving the benefits seen by industrial ecologists? To an economist, the question is why markets are failing to incorporate on their own the objectives of industrial ecology. The answer is that markets need to be fundamentally restructured so that prices reflect the full social costs of production. Reconfigured markets, combined with proper incentives such as emissions and effluent fees, could persuade more firms to act in environmentally beneficial ways. To achieve this fix, however, policymakers—particularly in the United States—would have to abandon their impulse for central planning and direct regulation.

## **The Roots of Industrial Ecology**

Like all serious ideas, industrial ecology has origins in earlier work. Much of this research took place at RFF in the 1960s and 1970s, where early work in environmental economics supported the development of integrated policies and practices in environmental and natural resources management. One research topic being addressed here at that time was residuals management in specific industries and regions. That is,

RFF researchers were examining economic activity based primarily on a simple fact: the sum-total of materials and energy flowing through the economy must be accounted for, either as part of a process, product, or service, or as "leftovers." Residuals—waste materials and the energy not fully used in either production or consumption—must go somewhere, according to the first (materials balance) law of thermodynamics. They can simply be returned to the environment in the water, land, or air; alternatively, wastes from one plant or industry can become the material or energy resources for other processes, plants, or industries. Environmental pollution illustrates the former; the well-known "ecoindustrial" complex in Kalundborg, Denmark is one example of the latter.

Why does industry fail to incorporate recovery and recycling practices more routinely into its operations? In large part, business practices, the laws and regulations that govern them, and the markets in which they operate, all conform to conventional economic conceptions of production and consumption processes. Unfortunately, economists have by and large ignored the important flows of materials through the economy and the physical laws governing them. Goods and services in the marketplace are made out of something, but classical models generally fail to consider where that something comes from and where it goes. (Even the term consumption as commonly used by economists is apt to be misleading, since what in fact is consumed in market transactions is not a physical mass but a flow of services from that physical mass that are involved in production and consumption.)



*The industrial ecosystem at Kalundborg, Denmark*

Working at Resources for the Future, Robert Ayres, Ralph d'Arge, and I borrowed the ideas of mass conservation and materials balance from the physical sciences in order to model and analyze the flows of materials through the economy. While the model that resulted is somewhat technical, its basic ideas are simple: the environment can be viewed as a large shell (see page 12 illustration) surrounding the economic system, providing sustenance and carrying away wastes. Broadly stated, the mass of residuals returned to the natural environment must be equal to the mass of basic fuels, food, minerals, and other raw materials entering the processing and production system, plus atmospheric gases. This principle must hold true for each sector of the economy taken separately and for economic systems taken as a whole.

Resource use, production, and consumption, seen from this perspective, could be aptly described as processes of materials and energy throughput and balanced materials flows. More importantly, these

processes are intimately bound together with the problems of residuals disposal, and hence with the pollution of air, land, and water that occurs when the capability of the environment to absorb and assimilate the returning materials is overwhelmed. Considering problems of air, water, and solid waste in isolation from each other is thus insupportable, even though our laws and regulations, then as now, treat each environmental medium separately and as the locus of largely isolated problems.

The powerful incentives and price-setting effects of markets now operate in the economy for natural resources (such as oil, minerals, and agricultural land) that serve as commodities. In contrast, markets exist only highly imperfectly or not at all for the environmental resources to which most residuals are usually returned, such as regional or global airsheds and watercourses. Instead, these are seen as "common property" that falls outside normal market exchange. Thus their price is effectively set as zero. Such

resources tend to be used for the disposal of residuals as though for other purposes they are valueless. Unfortunately, laws meant to control such use rely upon efforts to regulate their use directly, not to correct the faulty price signals given by the market concerning the use of common property resources. Thus they are fighting the price system rather than working with it.

### Applying the Research

Research at RFF evolved over time toward establishing quantitative estimates for relationships that the theoretical work suggested might be important. Robert Ayres went on from RFF to continue this work, helping it to grow into a discipline now widely known as industrial metabolism. (A significant underpinning of industrial ecology, industrial metabolism can be defined as the integrated set of all

physical processes that convert raw materials, energy, and labor into products and waste byproducts.)

Work within RFF on residuals management continued along two main lines. Clifford Russell, William Vaughan, Blair Bower, and others focused on the individual plant level, examining materials balances and flows and how they related to prices, including both prices for "normal" inputs and outputs and (experimentally) for residuals discharges (services of common property resources or emissions fees). Quantitative studies examined the petroleum and steel industries, among others, embodying materials balance concepts and other innovative procedures.

A second line of RFF research applied these ideas on a regional basis, specifically to the heavily industrialized and populated lower Delaware River valley. Bower, Russell, and Walter Spofford developed an environmental quality model accounting for materials flows and balances to test the significant linkages, including costs, among the management of different types of residuals in a regional context. Later studies

(with an amended version of the model) examined how incentive (pricing) approaches can be made to yield such desired results as meeting regional environmental standards at the least cost to the region.

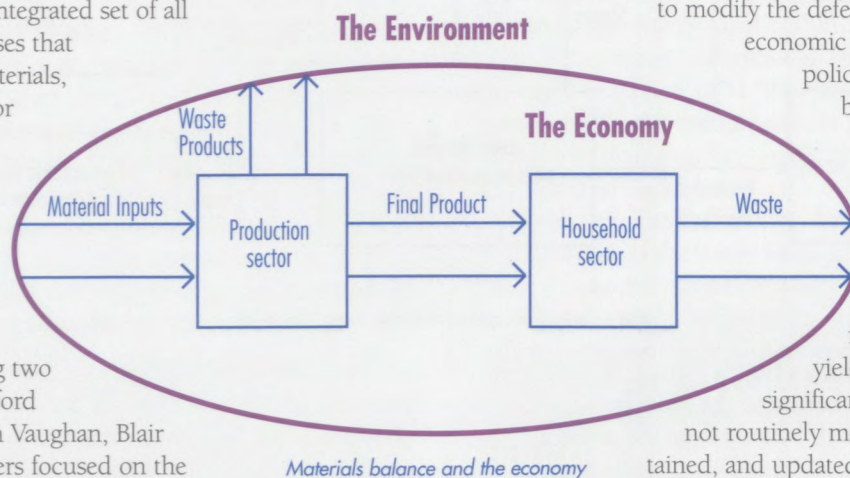
### Implications for Policymaking

These early RFF studies are of more than archival interest; in the intervening years, policies based on command and control have changed hardly at all. A number of other countries regard environmental degradation to result largely from a failure in the system of economic incentives, much as I have argued here, and attempt to remedy it through emissions fees policies (more popularly referred to as "green taxes"). The United States, however, continues with a policy approach that is fragmented and grossly overdependent on direct regulation rather than one that attempts

to modify the defective system of economic incentives. A new policy departure could benefit from the comprehensive RFF models. While these studies have been highly useful as research tools, yielding a number of significant insights, they are not routinely modified, maintained, and updated broadly for the regions across the country.

Such systematic attention would be required for these models to support rigorously justifiable pricing systems for environmental resources. But the gains thought to be achievable through industrial ecology could not in any case be reaped through central planning and direct regulation. The futility, or worse, of this approach is revealed in the disastrous results it has produced in economies all across the world where it has been tried as a tool of industrial development and management. In contrast, correcting the pricing systems may reveal the apparent gains touted by industrial ecology to be little more than artifacts of a distorted system of economic incentives.

An alternative policy approach that allows for more flexible, decentralized, and dynamic adjustments



invites serious consideration. A plan to "get the prices right" by correcting incentives currently distorted by the price system and misguided public policies should proceed on two fronts, involving subsidies and fees.

**Subsidies**—First, the subsidies that have historically been built into our economic system to aid rapid and large-scale exploitation of natural resources ought to be re-examined. They have encouraged excessive use of materials in general and attached false economic advantages to the use of virgin rather than recycled materials. These incentives reinforce the failure to price common-property resources by increasing throughput of materials and energy in the economy. Removing them will mean higher prices (for energy, for example), but these changes should be carefully distinguished from inflationary increases. They reflect the embedding in prices of the newly unsubsidized costs of particular goods and services.

One means for adjusting these incentives would be to scrutinize depletion allowances and other tax policies that favor more rapid exploitation of natural resources. Producers of most mineral and energy products, such as petroleum, lead, zinc, copper, and bauxite, receive special treatment that effectively reduces their tax rates. This practice keeps their prices lower than they would otherwise be, and thus encourages the use of virgin materials vis à vis recycled ones. Other examples are the remaining agricultural subsidies embedded in our farm policies and the extremely low prices for government-supplied water in the arid west. Such subsidies, while often entirely inappropriate to current circumstances, are so embedded in our overall economic system that phasing them out might in given cases require some form of adjustment assistance.

**Fees**—A second policy initiative to combat perverse incentives would involve directly and systematically encouraging the conservation of environmental (common property) media through the use of effluent and emissions fees—"green taxes." Creating and maintaining a fully coherent, organized set of effluent taxes based on economic modeling analyses is not possible at this time due to excessive information requirements. However, levying such taxes across a broad front of

activities that affect common property resources would recognize the interdependencies among environmental media and provide incentives for continuing development of processes that consume fewer materials or that are more conducive to recycling or treatment of residual materials.

### Conclusion

America's legal and regulatory systems address issues related to resource conservation and environmental improvement almost entirely through direct regulation of particular environmental media. Such an orientation continues to produce the familiar field days for lawyers, heavy costs, a huge bureaucracy, ad-hoc and capricious impacts, and far-reaching intrusion by government into decisions about the design of industrial processes.

An incentive-oriented (emissions fee) approach could not by itself deal with all of the sticky problems that arise in achieving environmental management objectives. For example, the discharge of highly toxic or persistent substances might still have to be prohibited by law and prevented through regulation. Schedules of effluent and emissions taxes that truly minimized the costs of achieving pollution control objectives would be too complex for practical application, and the necessarily more simplified schedules would inevitably introduce some inefficiencies into the system.

The advantage that can be claimed for the incentives approach, therefore, is not that it is free of administrative problems, for it is not. Nor can it fully replicate a theoretical least-cost solution in achieving environmental objectives, such as that yielded in principle by the Delaware study. An incentives-based policy would, however, be based upon a sound conception—that prices should reflect all costs—and upon experience that shows the tremendous power of prices and markets as signals to improve the allocation of natural resources.

Allen V. Kneese is a senior fellow and resident consultant in the Quality of the Environment Division.



# Industrial Ecology: A Coming-of-Age Story

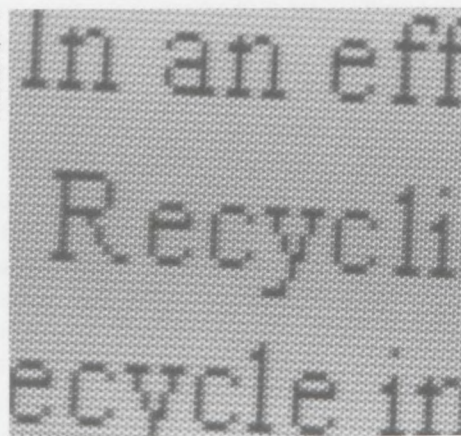
by Jesse H. Ausubel

The Greek *oikos*, for “house,” fathered the sibling terms economics and ecology. Economics, literally, is the house rules. Ecology is the branch of biology dealing with the mutual relations between organisms and their environment; it implies the webs of natural forces and organisms, their competition and cooperation, and how they live off one another.

Industry, according to the Oxford English Dictionary, is “intelligent or clever working” as well as the particular branches of productive labor. Reflecting in the late 1980s on the first two hundred years of the industrial revolution, several of us began to wonder whether it might be time for a new fusion of the old siblings, economics and ecology. (See J. H. Ausubel and H. E. Sladovich [eds.], *Technology and Environment*, National Academy Press, 1989.)

Industry had essentially solved the quantitative problem of production. Factories could readily and cheaply make

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masses of shoes the world might want and stamp out masses of cars like tin ducks. But the massive production also generated

massive byproduction. “Waste,” a seemingly trivial offspring of early economies, now seemed prepared to impoverish or murder its parents.

Green nature appeared to have gone far in solving this problem. In nature, webs connect organisms living together and consuming each other and each other’s waste. The webs have evolved so that communities of living organisms lose little or nothing that contains available energy or useful material. Industrial ecology asks whether nature can teach industry ways to go much further both in minimizing harmful waste and in maximizing the economical use of waste and also of products at the ends of their lives as inputs to other processes and industries.

A group of us, including Robert Frosch, Robert Ayres, and Braden Allenby, set off

## Thinking about Environmental Federalism

by Wallace E. Oates

Environmental federalism is a complicated and contentious issue. And it is at the center of debates both in this country and in the European Union, where moves are afoot for the harmonization of environmental standards across the member nations. It is helpful in thinking about this issue to go back to some basic “principles.” Doing so may not resolve the issue, but at least we can better understand the nature of the argument.

First, the issue is not a simple one of centralization versus decentralization of environmental management. Our governmental systems consist of several levels, and it is clear that there are important roles for nearly all levels of government in environmental protection. The issue is one of aligning specific responsibilities and regulatory instruments with the different levels of government so as best to achieve our

environmental objectives.

Second, there exists a body of “principles” (or, perhaps better, “rough guidelines”) for making this assignment. In brief (and with some simplification), the central idea emerging from the literature in public economics is that the responsibility for providing a particular public service should be assigned to the smallest jurisdiction whose geographical scope encompasses the relevant benefits and costs associated with the provision of the service.

The rationale for this principle is straightforward. Such decentralization of public decisionmaking allows outputs of public services to be tailored to the particular circumstances—the tastes of residents, the costs of production, and any other peculiar local features—of each jurisdiction. It is easy to show formally that such a decentralized outcome increases social

well-being as compared with a centralized solution requiring more uniform levels of public services across all jurisdictions. In Europe, this is known as the “principle of subsidiarity,” and it is enshrined in the Maastricht Treaty for the European Union. In the United States, we think of it more colloquially—as an aversion to the “one size fits all” approach.

Applying this general framework, we can envision a system of environmental management in which the central government sets standards and oversees measures for explicitly national pollution problems and intervenes where pollutants (like acid rain) flow across state and local boundaries; in addition, the central government would support research and the dissemination of knowledge on environmental issues, which benefit people everywhere. At the same time, the states and localities

under the banner of "industrial ecology" to explore whether we could massively reduce or do away with all waste. The banner captured attention in industry, government, and academia. The National Academy of Sciences and AT&T convened a colloquium on industrial ecology in 1991. Since then, workshops, many organized by the National Academy of Engineering, have addressed facets of industrial ecology, including its bearing in manufacturing and services industries, symbiotic co-location of industries, experiences in different nations, relationship to global environmental problems, and performance measures.

The welter of emerging ideas stimulated the Lawrence Livermore National Laboratory to invite the sorting out of directions for research. During 1995-97 a couple of dozen people participated in the process, which Iddo Wernick and I reported on. Our view is that the goal of industrial ecology is to lighten the environmental impact per person and per dollar of economic activity; the role of industrial ecology is to find leverage, the

opportunities for considerable improvement from practical effort.

Industrial ecology searches for leverage wherever it may lie in the chain from extraction and primary production through "final" consumption, that is, "from cradle to rebirth." Mindful of the endless reincar-

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**Mindful of the endless reincarnations of materials, the authors of the report refer to themselves as the "Vishnus," for the Hindu god known as the preserver.**

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nations of materials, the authors of the report refer to themselves as the "Vishnus," for the Hindu god known as the preserver.

The report discusses several means for lessening impacts, including:

**Zero emissions.** Chances and ways to move from leaky to looped systems, and plausible scenarios for the transition from leaks to loops, especially for energy.

**Materials substitution.** Opportunities for changes in material properties to reduce environmental burdens and the time scales for improved or new materials to occupy markets.

**Dematerialization.** Trends in delivering equal or more services with less stuff.

**Decarbonization.** Evolution of the energy system for more service while burning less carbon, through more low-carbon fuel (natural gas) or no-carbon fuel (hydrogen) and through more efficient generation, distribution, and use.

**Functionality economy.** Reconceptualization of industries as satisfying wants (such as floor coverings) rather than selling goods (carpets).

The report also explores methods for discovering and measuring progress, including:

**Materials flow and balance analyses.** Comprehensive accounting for industrial ecosystems at several levels (firm, sector, region) by elements (such as chlorine or cadmium) and by sectors (such as wood products or automobiles). This work was pioneered at

*Continued on page 16*

would set their own standards and would manage environmental quality for matters that are contained within their own borders (such things, perhaps, as drinking water, refuse disposal, and air pollutants with solely local effects).

Is this, in fact, the way we do things? Not exactly (as they say in the Hertz ads). Under the Clean Air Act, for example, Congress has directed the Environmental Protection Agency to set uniform national standards for air quality—applicable to every point in the United States. Such standards apply irrespective of whether there is any transporting of pollution across jurisdictional lines. Curiously, under the Clean Water Act in contrast, Congress has given the states the responsibility (but subject to EPA approval) for setting their own standards for water quality. Environmental policy in the United States (and Europe as well) is characterized by a certain ambivalence on this matter.

What is the objection to decentralized environmental management? One objection (and this is where things get more



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complicated) is that state and local governments, in their eagerness to promote economic development through attracting new business investment and creating jobs, will set excessively lax environmental standards to keep down costs of pollution control. What results (so the argument goes) is a "race to the bottom" with states and localities competing with one another to reduce environmental standards. We

thus need centralized standard setting and environmental management, as one author has put it, to "save the states from themselves."

But is this true? Note that this is really part of a more general and quite fundamental indictment of all state and local governance that says that economic com-

*Continued on page 16*

Ausubel, from page 15

RFF (see Allen Kneese's feature in this issue).

**Life cycle analyses of products.** Only a handful, such as Styrofoam cups and diapers, have been analyzed, and we need quick, reasonably accurate ways to sketch many products as well as skills to detail the most important or subtle.

**Indicators.** Intensity-of-use, waste-to-product ratios, and a suite of other metrics or compasses need to be developed and tested to guide the economy to get more out of material and leak less.

Finally, the report points to levers to achieve the goals of industrial ecology. Some levers relate to choosing materials, designing products, and recovering materials. Others relate to institutional barriers

and incentives. For example, what are the prospects for waste markets and waste exchanges? Can accounting that better tracks materials improve both the environmental performance and profitability of firms? What leverage can be gained by changes in regulation of the recovery and transport of industrial wastes or by manufacturers taking back products?

The search for leverage is under way in the United States and around the world. The White House Council on Environmental Quality leads an industrial ecology interagency group soon to report on materials. The research scene is lively in Germany, the Netherlands, and a fast-growing list of other countries. The field now has a dedicated quarterly, *Journal of Industrial Ecology*. Lucent Technologies, AT&T, and the National Science

Foundation award fellowships to industrial ecologists. The first Gordon Conference on industrial ecology will take place in June 1998. In this emerging field, the simple, powerful idea that society must balance its accounts of materials and energy, which RFF nurtured in the 1970s, is coming of age.

Jesse H. Ausubel, an RFF university fellow, directs the Program for the Human Environment at the Rockefeller University.

The DOE report he coauthored with Iddo Wernick, "Industrial Ecology: Some Directions for Research," is available at [http://phe.rockefeller.edu/ie\\_agenda/](http://phe.rockefeller.edu/ie_agenda/).

Oates, from page 15

petition will lead these governments to misbehave—to underprovide public services so as to keep taxes and expensive regulations at excessively low levels. This is curious in one respect. We generally applaud the work of competitive forces in the private sector, where Adam Smith's invisible hand guides self-interested decisions into socially beneficent outcomes. But here we are told that competition is socially harmful in the public sector.

The theory on this is not entirely clear. Certain economic models, for example, find that competition among governments (as in the private sector) encourages precisely the right kinds of decisions. There is no race to the bottom. Active competition for new economic activity in these models provides precisely the correct signals for decisions on public expenditures and taxation. At the same time, it is not difficult to introduce elements (and not unrealistic ones) into these models that generate

distortions—in some instances in the form of excessively lax environmental standards. But the theory gives us no sense of the likely magnitude of the potential distortions. Unfortunately, at this juncture we

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**It simply doesn't make economic sense to insist that all jurisdictions adopt the same set of centrally determined standards for environmental quality.**

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cannot resolve this matter by an appeal to the evidence; existing studies of state and local competition, while of some interest, do not answer our question. At any rate, there exists little systematic evidence that supports the case for a race to the bottom.

My own sense is that there remains a strong case for extensive decentralized

environmental management encompassing the setting of standards as well as their enforcement. There has been an impressive growth in both the analytical and administrative capacities of state and local agencies. Moreover, it simply doesn't make economic sense to insist that all jurisdictions adopt the same set of centrally determined standards for environmental quality. Circumstances differ, and we should take advantage of the opportunities that this provides for a more flexible approach to environmental management. The problems of air and water quality management, for example, are very different between Southern California and Omaha (or Venice and Oslo, in the European setting) and these differences should manifest themselves in the stringency and the form of environmental regulations.

Wallace E. Oates is an RFF university fellow and a professor of economics at the University of Maryland.





# Critically Evaluating America's Pollution Control System

by Terry Davies

Early in 1994, researchers at RFF's Center for Risk Management commenced what arguably is the most comprehensive evaluation of the U.S. pollution control system ever conducted. Our findings, which are reported in the newly published RFF book *Pollution Control in the United States: Evaluating the System*, point to a system that for all its accomplishments is deeply and fundamentally flawed. The need for a major overhaul, not simply more tinkering, is imperative.

This ambitious project, which has involved the efforts of numerous RFF staffers, was initiated at the suggestion of the Andrew W. Mellon Foundation and funded by Mellon and the Smith Richardson Foundation.

The 336-page book that is the result examines the major mandates and functions of the Environmental Protection Agency. Drawing extensively on an array of government reports and similar data, it provides both a description of the system and an assessment of its flaws.

The book examines and evaluates the system using these criteria: whether the system has reduced pollution levels; whether it has targeted the most important problems; whether it has accomplished its goals efficiently; whether it has been responsive to a variety of social values; how it compares with the systems of other developed nations; and how well it can deal with future problems. The study focuses largely, although not entirely, on federal environmental efforts.

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## Strengths and Weaknesses

The present system has done much to improve environmental quality. Laws and regulations have reduced air pollution from automobiles and large point sources. Creative policies such as emissions trading have been developed, along with such

techniques for opening up the system as citizen suits, regulatory negotiations (convening the key parties to negotiate a draft rule), and the Toxics Release Inventory (which makes public the amount of toxics produced by individual facilities). Many advances have been made in the science and engineering of pollution control.

Nevertheless, our study shows that the system is by nature fragmented. As a result, resolving certain types of problems is sometimes not simply difficult, but

difficult, and greatly reduces the effectiveness of pollution control.

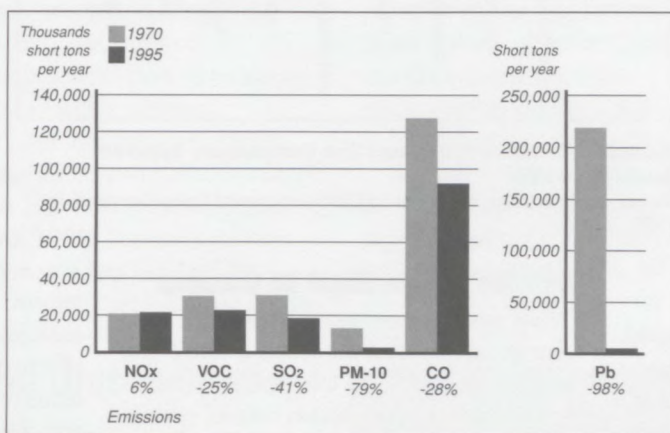
Beyond even these shortcomings, our evaluation reveals more critical flaws. The present system is focused for the most part at the wrong targets, is very inefficient, and is excessively intrusive.

**The Wrong Priorities.** Any gains in the effectiveness of policies and programs are hollow if the wrong problems are targeted. If one looks at what are the most serious health or environmental risks, one will find

little or no relationship to our current environmental regulatory priorities. Comparing EPA and societal expenditures with health and ecological risk rankings, we found a basic mismatch. Two top-ranking health risks that are at the top of many experts' lists—radon and indoor air pollution—receive minimal funding, while the highest expenditures on ecological risks—oil spills and hazardous waste sites—go to problems that do not even make it to most experts' lists of the major risks.

In water pollution, nonpoint sources pose the major problem, yet the current system still focuses on point sources. Indoor air pollution is the major health threat for most people, but the system focuses on outdoor air pollution. These are two of the most egregious examples, but by no means the only ones. Risk cannot be the only guide in setting priorities; other factors, such as cost, administrative feasibility, and fairness considerations, must be put into play. The basic goal of the system, however, is to reduce risk.

**Inefficiencies.** The inefficiency of the current control system goes beyond focusing on the wrong targets. The system discourages preventing pollution and focuses instead on end-of-pipe treatment. Prevention is often preferable, both environmentally and economically. The system



**National Air Pollution Emissions Trends, 1970-1995.**

Source: U.S. EPA. National Air Pollutant Emissions Trends, 1900-1995. Office of Air Quality Planning and Standards Research, 1996.

impossible. For instance, a recent report notes that the air deposition of mercury in the Everglades is twenty-five to fifty times greater than mercury discharges by water polluters. Yet the current regulatory system cannot deal with this situation effectively, because our water pollution laws ignore altogether the possibility that some pollutants end up in water bodies via the air.

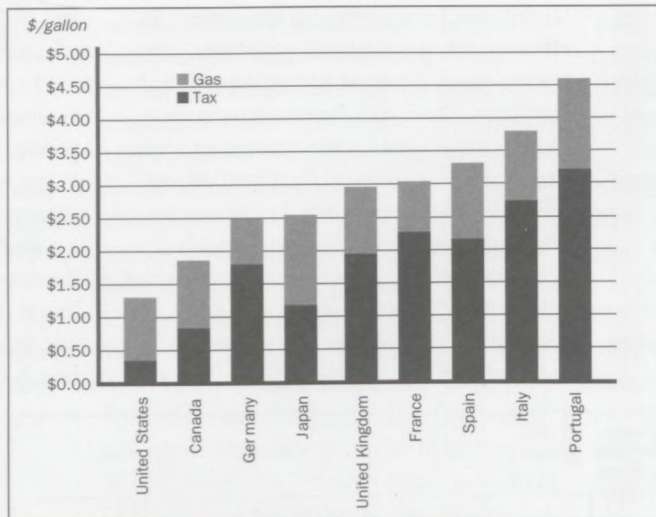
The most important shortcomings of the system are due to Congress, not EPA or the states. It is Congress that has proliferated environmental statutes, failed to think through how they ought to interrelate, failed to set priorities, and perpetuated the myth of freedom from risk. The fragmentation that results increases the costs of compliance, encourages cross-media trans-

also is excessively prescriptive, telling sources how to control pollution instead of setting a goal and allowing flexibility in how to meet it. There is ample evidence that the prescriptive approach adds large sums to the cost of control, money that comes from taxpayers' pocketbooks and that is not buying anything.

The costs of controlling pollution are borne largely by the private sector. Direct EPA expenditures are a small portion of the cost. More efficient EPA regulations, however, could reduce costs paid by all parties as well as reducing the intrusiveness of the control system.

**Intrusiveness.** The intrusiveness of the present system not only works against some of its own goals, but also generates bitter public resistance. It tells people what to do rather than providing incentives for them to take necessary action. Its recordkeeping requirements and other bureaucratic aspects can be onerous and often are duplicative or otherwise unnecessary.

Developing alternatives to these shortcomings is a major challenge to any reform effort. One major set of remedies that has been proposed is increased use of "market mechanisms," using pollution taxes, marketable permits, and deposit-refund schemes as ways to reduce and control costs. The United States has pioneered some of these mechanisms, such as the trading of emissions rights, and Resources for the Future can legitimately claim to be one of the intellectual parents of market mechanisms. However, many other countries make greater use of taxes as a way of curbing fuel use than does the United States.

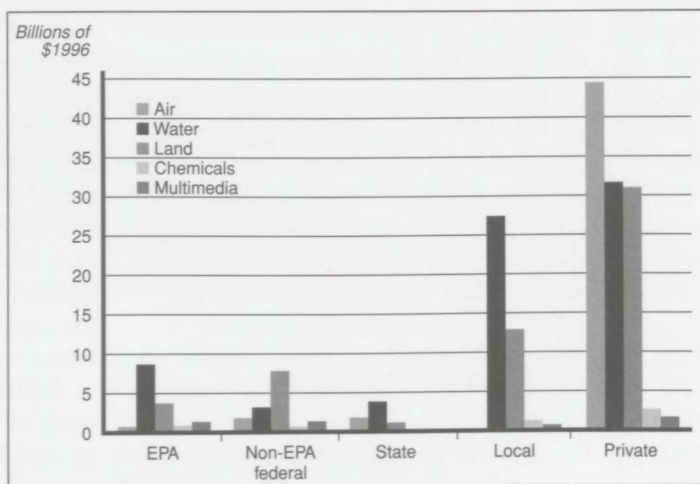


**Unleaded Gasoline Prices and Tax Component, Selected Countries, 1994.**

Source: RFF calculations based on OECD Environmental Data: Compendium 1995, p. 230.

### How the System Might Be Changed

While making recommendations for change falls beyond the scope of our evaluation project, one can infer the characteristics of a reformed pollution control system from our findings. It would have to be results-oriented, perhaps with EPA's regulatory and assistance efforts focused on



**Total Costs by Medium and Funding Source.**

Source: U.S. EPA, Environmental Investments: The Cost of a Clean Environment, 1990; Table 8-12A, p. 8-51.

Note: Present implementation cost of regulations, annualized at 7%.

places and economic sectors. It would be integrated throughout, rather than being divided into separate air-water-land categories. It would be efficient, taking costs into account. And it would be more participatory and less coercive. Aside from its fragmentation, the current system's other great failure is its lack of adequate scientific, monitoring, and social science information. A performance-based system will need information for measuring performance.

Possibilities for changing the present system are good, but those changes will probably not take place as fast as is necessary. Many of the national environmental organizations have come to be the arch-conservatives on the matter of

reform, opposing nearly all significant changes. Such a position will damage their effectiveness in the long run. Industry tends to focus more on the bottom line, and thus will need outside incentives to motivate compliance. But industry is far from unified regarding environmental policy: even similar large companies disagree about such basic issues as

whether to encourage decentralization to the states. The picture of the principal stakeholders in the pollution control system, then, is nearly as complicated as the system itself.

As one who was involved in environmental matters before there was an EPA and when few outside of scientific circles had heard of ecology, I remain optimistic concerning reform of the nation's pollution control system. But there is clearly still a long way to go.

Terry Davies is the director of RFF's Center for Risk Management.



## ANNOUNCEMENTS

### Summer internships

RFF is now accepting applications for its 1998 summer internships, scheduled to run this year from June 2 through August 29. As in the past, approximately a dozen students will be selected to work directly with RFF researchers in one of three divisions on a variety of ongoing projects and to assist in developing new areas of research and policy analysis. A modest stipend is offered.

All three divisions seek candidates with policy analysis and writing skills and an interest in environmental policy problems that lend themselves to interdisciplinary analysis.

The Energy and Natural Resources and Quality of the Environment divisions additionally require strong backgrounds and interests in microeconomics, quantitative methods, policy analysis, and social or natural sciences.

Applicants may apply to one or more divisions by submitting the following materials: cover letter describing interests, resume, academic transcript, and letter of recommendation sent directly by a faculty member.

All application materials should be postmarked or faxed to 202-939-3460 by **March 16, 1998**. For more information, see <http://www.rff.org>

### China Program internship

Graduate students with a special interest in environmental economics as they affect China are encouraged to apply for the **Walter O. Spofford Jr. Memorial Internship**, named to honor the late RFF researcher who helped launch RFF's China Program.

In establishing the internship, RFF intends to further the cooperative work that Spofford engaged in with experts in China to strike a balance between environmental standards and sustainable economic growth.

The application requirements, deadline, and calendar are the same as for the other RFF summer internships. ☺

### Ordering books

To purchase books, add \$4.00 for shipping to the price of the first book ordered; add 50 cents for each additional book. Send a check payable to Resources for the Future to: Resources for the Future, Customer Services, P. O. Box 4852, Hampden Station, Baltimore, MD 21211-2190.

Books and reports may be ordered by telephoning 410-516-6955. MasterCard and VISA charges may be made on telephone orders.

### Ordering discussion papers

Discussion papers may be ordered through RFF. The price per paper covers production and postage costs and is based on delivery preference: domestic, \$6 for book rate and \$10 for first class; international, US\$8 for surface and US\$15 for air mail. Canadian and overseas payments must be in U.S. dollars payable through a U.S. bank.

Please send a written request and a check payable to Resources for the Future to: Discussion Papers, External Affairs, Resources for the Future, 1616 P Street, NW, Washington, DC 20036-1400. Recent discussion papers are accessible electronically at <http://www.rff.org>

### Pollution Control in the United States: Evaluating the System

By J. Clarence Davies and Jan Mazurek

"This is the most thorough and balanced analysis to date of the successes and failures of our pollution control system. Anyone concerned about the environment should read this book to understand why our regulatory system often fails, and how it must be changed if we want better results."

**Norman J. Vig**, *Carleton College*

"Sure to become a classic in the environmental field. Davies and Mazurek cut through the fog of the current regulatory reform debate with clear thinking and careful analysis. They define the state of the art in governmental program evaluation."

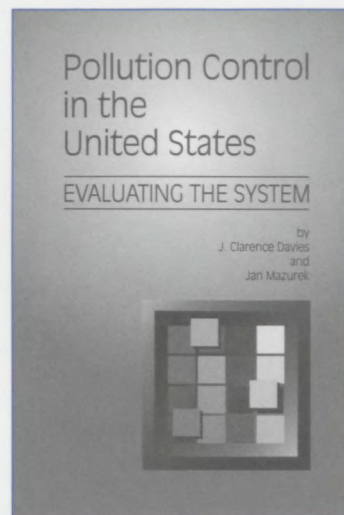
**Dan Esty**, *Yale Center for Environmental Law and Policy*

J. Clarence Davies directs the Center for Risk Management at RFF. Jan Mazurek, formerly with CRM, is author of the forthcoming *Making Microchips: Policy, Globalization, and Economic Restructuring in the Semiconductor Industry* (MIT Press).

### Also now available

**Partha Dasgupta**, *Environmental and Resource Economics in the World of the Poor*, Paperback \$7.95, ISBN 0-915707-91-8

**Robert Solow**, *An Almost Practical Step toward Sustainability*, Paperback \$7.95, ISBN 0-915707-92-6



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## Putting People in the Picture: Alan Krupnick measures the human factor

*Resources has begun an occasional series of talks with researchers about their personal backgrounds, approaches, and expectations in exploring various aspects of environmental economics. This first profile is of Senior Fellow Alan Krupnick, who has been with RFF for nearly twenty years.*

Two kinds of people are attracted to environmental research, Alan Krupnick says—those who love critters and trees, and those who zero in on people and health. “Where I grew up in Philadelphia, we had a lot more people than birds,” the senior fellow says. “So you can guess what kind of researcher I am.”

As a budding economist in the 1970s, Krupnick saw a need to understand the human factor in environmental policy. He saw the new field of environmental economics as a place to “get in on the ground floor intellectually.” RFF was “premier in terms of output and new ideas” at the time. What drew him to join the organization was RFF’s location in Washington as well.

“You come here as an economist if you want to mix it up and get your hands dirty in the policy debate,” Krupnick says. But, unlike most of the others at the federal policymaking table, the RFF scholar does not represent any of the stakeholders. “We try to make the case for efficiency. There’s an old saying that there’s no constituency for efficiency; we provide one to the extent that we can.”

Krupnick brings three special attributes to this role of defending the long-term inter-

ests of taxpayers and consumers: a fascination with “the beauty of the market—how under certain circumstances social welfare is maximized when you let the markets run”; a drive to “unlock the secrets of people’s behavior in the economic sphere”; and a joy in working with groups of people. He loves “large complicated research problems that you cannot take on without pulling together a research team.”

The economist’s romance with the market has endured. At Columbia University’s international business school, he turned away from the simple goal of “selling more soft drinks to Ugandans,” Krupnick recalls. Drawn to the counterculture of his generation, his own free spirit continued to appreciate the free market nonetheless.

What he settled on was a role midway between a profit-

driven entrepreneur and a radical politician, the role of an economist. “Economics as the pursuit of social welfare—that is, finding ways that Ugandans can become better off—that’s what attracted me.” The irony, he points out, is that environmental markets are plagued by

constant interference from “visible hands” and market distortions that undercut the good work that he believes the classic “invisible hand” could bring about.

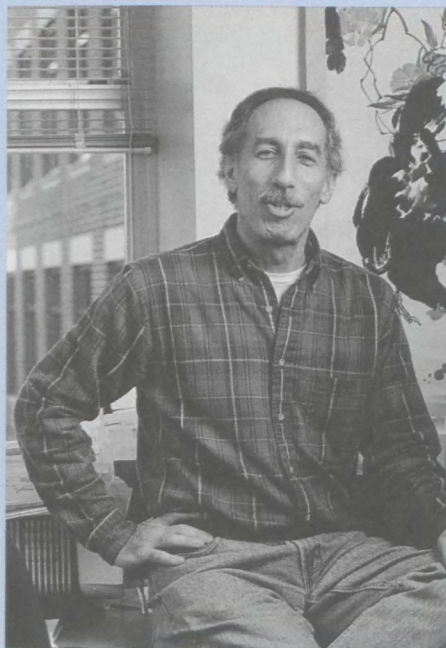
But this dauntingly stubborn problem appeals to Krupnick’s spirit of adventure. “I love collecting data that no one ever collected before, surveying people about their preferences or looking at available data in a new way.” Currently, he is experimenting with what may turn out to be a breakthrough way to measure just how much people value

reducing their risk of dying prematurely from exposure to air pollution. He is dissatisfied with traditional approaches that extrapolate from data about on-the-job risks of accidental death.

Using “life years saved” as an alternative measure “potentially is a big deal,” he thinks. The survey he is helping to develop will first be applied in Japan and then, he hopes, in the United States and the United Kingdom. The range of venues will allow a look at how culture affects people’s preferences in this area. Eventually, he would like to apply the analysis to developing countries such as India and China, where the choice between human health and poverty is often stark. “It’s really important to get information on how people see the tradeoffs there.”

This behavior-oriented analysis is the kind Krupnick thrives on. (His doctoral dissertation at the University of Maryland measured the effects of pollution on worker productivity.) It also thrusts him into some highly charged policy debates centered on the use of cost-benefit analysis for environmental issues.

His interest in group interactions is probably best measured by his lifelong sessions



*In the groove at Penn State, 1966. Alan's the fifth "guy" at right.*

at the keyboard. Ever since his undergraduate days at Penn State, he has loved playing music—and still does, be it with his two young daughters at home, with aging professionals in lounge-lizard gigs on weekends, or as an accompanist for some of his neighbors in a community whose musical lights range from accordion to zither players with opera singers in between.

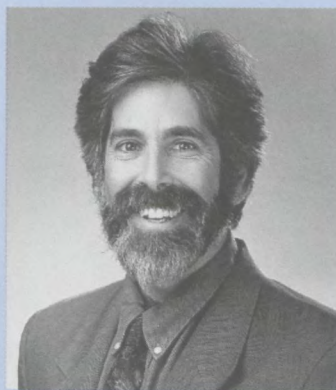
There is not that much difference hearing him talk about these music gigs and

about various policy “jam sessions” during his time at the White House Council of Economic Advisers—or his work currently as the co-chair, and the lone economist, on an orchestra-sized federal advisory subcommittee. What he likes about RFF, Krupnick says, is that, unlike the isolation of many academic settings, it is well populated with scholars ready to “mix it up.” ☞

## Newly promoted fellow

Robert Hersh received a promotion to the rank of fellow in RFF's Center for Risk Management this past fall. Until his promotion, Hersh was a research associate with the center, where he began working in 1992.

An analyst of integrated pollution control initiatives on an international level, Hersh has also been examining the policy implications of incorporating land use into cleanup



decisions at Superfund sites and is a primary author of the RFF report, “Linking Land Use and Superfund Cleanups: Unchartered Territory.”

Hersh holds an M.A. in urban and environmental policy from Tufts University, a certificate in environmental management from the United Nations Environment Program, an M.A. in telecommunication arts from the University of Michigan, and a B.A. in English literature from the University of Sussex.

He received a United Nations Environment Program

Fellowship in 1991. He is also a recipient of the University of Michigan's Leland Stowe Journalism Award and its Leo Burnett Scholarship for research in visual communication. ☞

## New development director

Evita Sherman-Dixon is RFF's new director of development.

Before joining RFF, Sherman-Dixon was a major gifts officer for the Johns Hopkins University's Zanvyl Krieger School of Arts and Sciences. Her experience also includes a series of positions with United Way, the most recent of which was as vice president for major/planned gifts at United Way Central Maryland.



Sherman-Dixon holds a B.A. in international relations and Latin American studies from the American University.

She replaces RFF's former development director, Nancy Hiles. ☞

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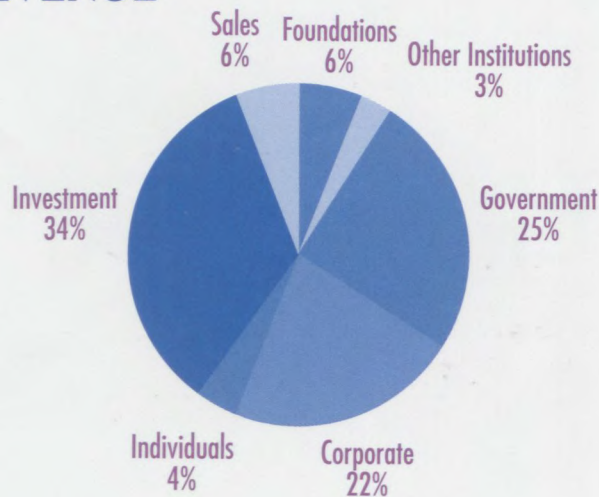
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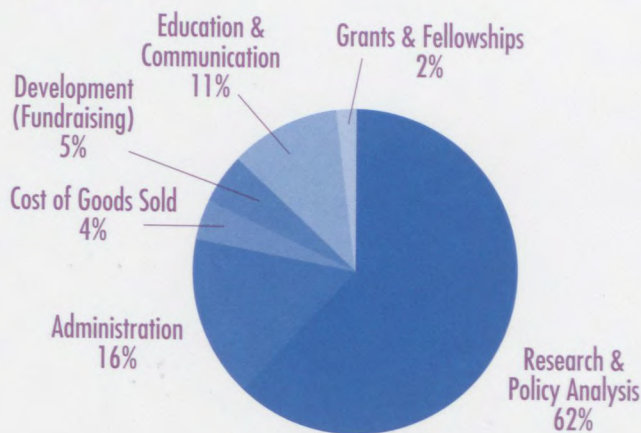
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