SUMMER 2000
ISSUE 140

RESOURCES

RESOURCES FOR THE FUTURE RESEARCH THAT MAKES A DIFFERENCE

Paul R. Portney

Finding the Right Tools for the Job

This is the season when Presidential candidates test their messages in earnest in the run-up to November. It seems that almost every day we hear about a new proposal to magically fix some major national problem, whether it be energy prices, Social Security, or missile defense.

For those accustomed to getting their news in 30-second sound bites, this issue of *Resources* may seem irrelevant to the daily pronouncements from Texas or Tennessee. But beneath the partisan prescriptions from both camps is a series of policy proposals that must be analyzed and dissected to determine whether, and in what circumstances, they are likely to work.

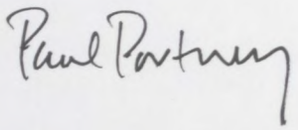
In this issue we look at three highly-touted policy tools and discover that, at least among researchers, there is a healthy skepticism about the conditions needed to ensure that they deliver as promised.

At a time when many hope that technological innovation can help us address climate change painlessly, RFF Fellow Richard Newell looks from an economist's perspective at the role that government incentives can play in encouraging technological innovation.

Similarly, RFF Fellow Jim Sanchirico examines the empirical evidence regarding the now-prevalent use of no-fishing zones to save flagging fish stocks. RFF Visiting Scholar Ruth Greenspan Bell and Senior Fellow James Wilson ask what role formal risk assessment should play in addressing environmental and health problems in developing countries, which often lack well-developed regulatory institutions to carry out the sophisticated solutions that risk assessment may prescribe.

Although this kind of analysis is certainly less glamorous than a stump speech, we believe one of RFF's primary skills is in analyzing these kinds of tools to help policymakers use them most effectively.

In the next issue we'll find out who is listening. As we have done in the past, we plan to preview the November election by asking the presidential candidates questions about some of the most pressing environmental issues facing the country. Stay tuned for more.



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GOINGS ON

RFF Scholar Discusses Public Participation in Environmental Policymaking in China

RFF visiting scholar Ruth Greenspan Bell recently spoke in five Chinese cities about how public participation, a component of effective U.S. environmental policymaking, could affect China's developing environmental regulatory system. As a guest of the Speaker Program of the U.S. Department of State, Bell spoke in Hong Kong, Guangzhou, Chongqing, Beijing, and Shanghai. In some cases, she spoke to large groups, but most of the smaller sessions were informal, functioning as mutual learning sessions with Chinese environmental professionals.

In her more formal presentations, Bell discussed the advantages of public participation, an evolving issue in China. She explained how the environmental public interest community and other interested members of the U.S. public, through lawsuits and pressure, gave content to environmental impact assessment following the passage of the National Environmental Policy Act (NEPA) in 1969. China has environmental impact assessment requirements in its laws, as do many countries, but Chinese environmental officials would like to find ways to better integrate the findings of these assessments into the decision process on large-scale development projects.

More and more, high Chinese government officials, such as Vice Premier Wen Jiabao, are stressing the importance of integrating environmental concerns into economic development, and mobilizing common participation as part of the process. In her discussions with environmental protection officials, students, nongovernmental organizations (NGOs), and the Chinese environmental press, Bell approached public participation as an aspect of pragmatism. She discussed how involving the public can help environmental regulators obtain useful and necessary information to improve regulations and make them more realistic. She also explained that a public process could help build public trust, an important factor in establishing the legitimacy of new requirements.

RFF visiting scholar Ruth Greenspan Bell and Mark Canning, counselor for Press and Culture with the U.S. Consulate in Guangzhou, visit a local environmental newspaper.

China is one of the world's fastest growing economies. Because economic development has traditionally been considered a greater priority than environmental protection, a range of development-related environmental problems has emerged. In fact, six of the world's ten most polluted cities are located in China. Bell reports, however, that there has been increased emphasis on the environment throughout China, apparently sanctioned by the government. *The China Daily* prints environmental stories almost daily. And in Guangzhou, Bell visited an environmental newspaper and a training school for environmental monitoring.

Even though environmental law implementation remains poor and economic development still receives priority attention, there are some signs of change, Bell says. In Beijing, a Center for Legal Assistance to Pollution Victims has been established in the China University of Political Science and Law. The Center conducts interdisciplinary research on environmental law, arranges training for enforcement and court officials, and provides legal assistance to protect the environmental rights and interests of pollution victims.

The May 16 *New York Times* reported on one of the Center's cases, in which compensation was sought for a farmer who lost several hundred of his ducks as a result of pollution from an upstream business. Although the suit is not yet resolved, it is considered important in the effort to improve the implementation of many relatively new Chinese environmental laws. Bell hopes that the Center's recent legal action is an example of China's gradual movement toward a rule-of-law society.

GOINGS ON

Kyoto Protocol Negotiators Discuss Compliance Options at RFF/CIRED Workshop in Paris

RFF and the French Centre National de la Rechereche Scientifique (CIRED) recently sponsored an international workshop to explore concerns about the potentially high costs of achieving the Kyoto targets along with the related issue of incentives for long-term technology development. Attendees at "Compliance and Supplementarity in the Kyoto Framework" included senior negotiators of the Kyoto Protocol along with various nongovernmental experts from both developed and developing countries. The workshop was held near Paris in late June.

Discussions centered on two new policy papers developed by U.S. and French researchers. The first, by RFF scholars Raymond Kopp, Richard Morgenstern, and William Pizer, addressed concerns expressed in the United States and elsewhere that the binding emission limitations contained in the Protocol may prove to be very costly to implement. In the second, CIRED director Jean-Charles Hourcade focused on whether excessive reliance on emissions trading and other flexibility mechanisms may discourage the long-term development and diffusion of new, environmentally friendly technologies. CIRED, the French national scientific research institute, has played a prominent role in climate change debates, particularly in Europe. This was the third joint RFF/CIRED workshop on climate change issues held over the past two years.

The RFF researchers proposed adding to the still-evolving Protocol a mechanism that would allow countries to make a predetermined compliance payment in lieu of pursuing excessively costly emission reduction options. The revenues from this compliance payment would be used to reduce additional emissions worldwide via a transparent auction mechanism. Despite the potential for relaxation of the Kyoto targets, the authors argued that adoption of the compliance payment mechanism would increase the likelihood of timely ratification and successful implementation of the Protocol.

RFF/CIRED workshop participants included representatives from Brazil, China, England, France, Germany, and the United States.

Workshop participants noted a certain symmetry between the RFF researchers' focus on cost containment and Hourcade's concerns that the costs may be too low to provide adequate long-term incentives for development of new technologies. In the context of the proposed cost cap, discussions focused on the possibility of limiting the use of sinks and so-called "hot air" in the first budget period, adoption of various indicators of domestic action, and mechanisms for accelerating the development of firm commitments for the second budget period and beyond.

Both papers and a summary of the discussions prepared by workshop co-chairs Hourcade and Morgenstern are available on *Weathervane*, RFF's Web site devoted to climate change issues (www.weathervane.rff.org). A second session of the RFF/CIRED workshop is planned for September, just before the next round of international climate negotiations. The 6th Conference of Parties will be held in The Hague this November.

The RFF/CIRED workshop series is supported by generous grants to RFF from the German Marshall Fund of the United States and the Wallace Global Fund for a Sustainable Future. Melissa Dann, Wallace Global Fund senior program officer, attended the workshop and said it was very interesting to watch the participants wrestle with the pros and cons of the compliance approaches outlined by the RFF and CIRED researchers. "What was especially impressive was RFF's genuine interest in exploring alternatives, making it a more honest broker in the eyes of the participants."

GOINGS ON

New RFF Project to Examine Electronics Disposal Management Practices

The growing importance of information technology to the world economy and to consumers in the United States and other developed countries has brought about a surge in demand for electronic equipment. According to recent estimates, shipments of personal computers in the United States grew from over 10 million units in 1992 to over 30 million units in 1997. Advances in computing technology are continuing to develop at a rapid pace, and, consequently, the useful life of electronic equipment tends to grow shorter with each successive generation. For example, in 1997, the average life span of a desktop personal computer was four to six years; by 2005, it is expected to be just two years. As a result, a growing fraction of electronic equipment becomes obsolete each year.

The increasing quantity of used electronic equipment poses new challenges for waste management officials. Because much of the equipment is bulky, it is costly to collect and takes up significant space in landfills. In addition, some equipment can contain hazardous materials, such as heavy metals or lead, which could be released into the environment during incineration or concentrated in incineration ash. In the United States alone, some experts estimate that approximately one billion pounds of lead from computers and other electronic devices will enter the waste stream within the next decade.

RFF Senior Fellows Karen Palmer and Molly Macauley, Fellow Jhih-Shyang Shih, intern Heather Holsinger, and Resident Scholar Margaret Walls will examine existing policies and practices in the United States and other developed countries to draw important lessons about the future of managing end-of-life electronics. They also will develop a simulation model to assess the economic–efficiency implications of different policies that promote recycling of equipment containing hazardous materials, such as computer monitors and televisions.

Several waste disposal policies have already been mandated or proposed, with varying degrees of success. In the United States, under Subtitle C of the Resources Conservation and Recovery Act, large commercial and industrial generators must dispose of used cathode ray tubes (from computer monitors and television sets) at a hazardous waste facility, which can be quite costly. Thus, many households and businesses are storing them, in the hopes of finding some valuable use for them in the future.

Current Practices

Currently Massachusetts is the only state that has banned the disposal of cathode ray tubes at all municipal solid waste landfills and incinerators. The state government has provided funding to municipalities to collect cathode ray tubes via contract recyclers and arrangements with charity organizations.

The European Union, in its July 1998 "Proposal for a Directive on Waste from Electrical and Electronic Equipment," called on member states to require distributors and manufacturers to take back for disposal electrical and electronic equipment when purchasers are through with this equipment, and to set ambitious recycling goals for that equipment. Although the proposal has been delayed, several countries including the United Kingdom, Sweden, and the Netherlands are developing their own regulations to establish manufacturer take-back systems for electronics.

A number of U.S. electronics manufacturers, including Apple Computer, Inc. and Compaq Computer Corporation, are taking matters into their own hands. In an effort to reduce the quantity of waste associated with their products, these companies are changing the design of their products to minimize unnecessary material use, extend product life, and/or make products easier to recycle.

The RFF researchers plan to analyze the effects of different policy options, such as deposit/refunds, environmental taxes, and landfill bans, on the behavior of recyclers, manufacturers, and consumers and on the ultimate effects of electronics waste management in general.

One policy option under review is the use of tradable credits. These credits would be similar to tradable emission allowances used by the electric utility sector to control pollution. Because tradable emission allowances have been effective in reducing the cost of controlling both air and water pollution, the researchers will explore the feasibility of targeting tradable credits toward the recovery of used electronics products or the greater use of secondary inputs by electronics manufacturers.

The researchers' initial focus on electronics disposal marks the first phase of a larger, two-year project on the economics of waste management in general. The full project will include a study of the optimal structure of contracts between municipalities and private companies for handling solid waste collection, disposal, and recycling. The researchers also will analyze the effects of carbon taxes and other types of carbon policies on recycling paper, plastic, aluminum, and solid waste in general.

The RFF team will develop a series of reports and a set of scholarly papers, and conduct presentations and briefings at international workshops and conferences.

Marine Protected Areas: Can They Revitalize Our Nation's Fisheries?

By James Sanchirico

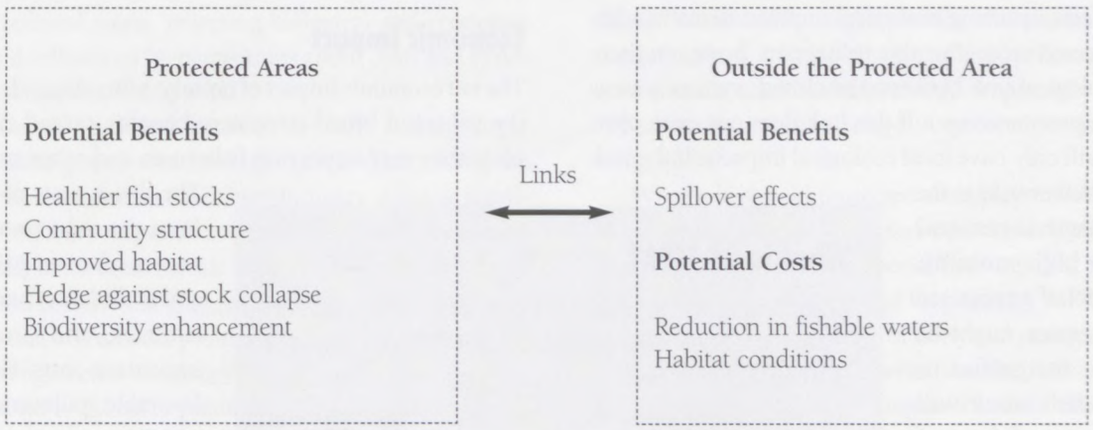
The Clinton Administration and conservationists have called for the establishment of a vast network of marine protected areas as a way to combat overfishing. But the success of this policy tool in helping fisheries recover is by no means assured.

As early as the 19th century, governments concerned about overexploitation of marine life during critical phases of the their life cycle established "no-take zones" to protect species like the Finnish Salmon, Canadian Atlantic Groundfish, and North Pacific Fur Seal. Now, with many fisheries in distress, policymakers are looking once again at the potential of marine protected areas (MPAs) to reduce the pressures of overfishing on the ocean ecosystem.

President Clinton announced in May that he would seek to dramatically increase the number of protected areas, and both the World Conservation Union and the parties to the UN Convention on Biological Diversity have called for a closure of 20% of the world's near-shore habitat. Advocates for setting aside areas free from exploitation claim that MPAs can deliver a plethora of benefits—including higher fish stocks and improved habitat—at very low costs. Not surprisingly, perhaps, many fishermen who might bear these costs claim the costs could be significant.

MPAs clearly are coming to occupy a prominent place in discussions about how to save declining fisheries. We reviewed the empirical and theoretical biological literature and determined that, from a biological standpoint, protected areas can improve conditions within the no-take zone; however, our research on the economic impacts has shown that other key questions are not so clear. There is very little information on the biological or economic effects of MPAs outside the protected areas and how these factors can affect success. For example, it is not clear how policymakers should account for the likely changes in the behavior of fishermen, whose reactions to the closure of certain areas can have both direct and indirect impacts on benefits and costs. The lack of information inhibits policymakers from assessing the true net costs and benefits of establishing MPAs, and from gaining a true picture of where and under what conditions they will be effective.

Potential Benefits and Costs of MPAs



The boundaries of the two areas are drawn with dashed lines to symbolize the openness of the marine ecosystem. The link between the two areas is formally defined by the migration/dispersal patterns of fish stocks residing within and outside the protected areas along with the geographic or oceanographic characteristics of the marine environment. In general, fish migration patterns depend upon currents, temperatures, prevailing winds, and behavioral characteristics. The term "community structure" refers to the potential benefits in age/size structure of the fish stock and in trophic levels present in the protected area.

Economic Assessment

From an economic perspective, MPAs represent a public investment, and cost-benefit and cost-effectiveness analyses can be used to measure their impact. Economic analysis is complicated by several factors, however; for example, the benefits of MPAs—healthier fish stocks—will be realized at some future date, whereas the majority of the costs are incurred initially. Also, even though the goal of an MPA may be fishery enhancement, the benefits MPAs provide may be broader in scope and include habitat improvements or the enhancement of other uses, such as recreation. Fishermen perceive that they will most likely bear the majority of the costs of closing areas without any guarantees that they will be the recipients of the benefits. Thus, inherent in the policy debate is the perceived transfer of resource rights from fishermen to others.

Further muddying the waters (so to speak!) are the biological and economic uncertainties inherent in complex fishery systems and the calculation of nonconsumptive use benefits. Valuing the benefits from activities such as education, diving, photography, and tourism that might arise from closing certain areas to fishing requires data not typically collected by fishery managers. Consequently, it is difficult to fully quantify the benefits from MPAs, leaving fishery managers, industry, and conservation organizations to speculate about their existence and magnitude.

Biological Benefits

Empirical evidence backs the contention that no-take zones can often yield many biological benefits within the zone, including reductions in: the pressure placed on exploited stocks, stresses on ecosystems, the amount of bycatch (inadvertent taking of another species), and destruction of the benthic environment (the ocean floor) from harmful fishing practices. MPAs also have been shown to increase the age and size of the fish stock, spur higher stock levels, and foster improvements in habitat. Although

the overall direction of positive changes is clear, it is difficult to predict the magnitude and forms of the changes in advance.

Some advocates also claim that MPAs will provide "spillover" effects, spurring ecological improvements in adjacent nonprotected areas. For this to happen, however, there must be a biological link between the closed and open areas (see figure on previous page). If this link does not exist, closing off areas will only have local ecological impacts. If the link is too strong, however, as in the case of a pelagic (open sea) species with high mobility, then the impact of a protected area fixed in space might be biologically insignificant, because the fish stock will likely spend most of the time outside the boundaries of the MPA. In general, the magnitude and nature of the spillover effects to the nonprotected areas depends on the biological openness of the system, which is defined by the dispersal of the fish stocks. As a result, understanding these fundamental processes is critical to determining the net biological benefits of MPAs.

Many proponents of MPAs claim that they will provide broad ecosystem benefits including improvements in habitat and restoration of healthy marine life communities throughout the ocean ecosystem. These benefits are most likely to be felt within the protected area, but again outside of this area the effects are unclear. Closing off an area will prompt fishermen to go elsewhere, putting new pressures on the remaining open grounds. This shift could mitigate any broad ecosystem benefits, because it could increase the intensity level of activities in the remaining nonprotected areas, further degrading habitat, and potentially creating a marine environment dotted with islands of productive habitat surrounded by vast expanses of depleted habitat. Fishing in some of the areas where fishermen choose to go in the face of closures could be more biologically detrimental than in the areas declared off-limits.

What is an MPA?

According to the International Union of Concerned Scientists (IUCN), a marine protected area (MPA) is "any area of intertidal or subtidal terrain, together with its overlying waters and associated flora, fauna, historical and cultural features, which has been preserved by legislation or other effective means to protect all or part of the enclosed environment." While the IUCN establishes a forward-looking agenda for setting aside areas, the current sanctuary system within the United States is based on more traditional goals and the use of set-aside areas. In the United States, the National Marine Sanctuary Act defines a sanctuary as an area of the marine environment of special national significance due to its resource or human-use values, designated as such to ensure its conservation and management. In general, MPAs by definition consist of well-delineated areas that either by decree or legislative action prohibit certain activities. The level of protection (no commercial fishing zones versus certain gear restrictions), the goals (e.g., fishery enhancement, biodiversity, and habitat restoration) and the size, shape, and location are all key talking points in the debate determining if protected areas are worthwhile.

Economic Impact

The net economic impact of no-take zones depends on whether the values of broad ecosystem benefits exceed the potential costs they may impose on fishermen and other current users. The direct costs of MPAs stem from the reduction in fishable waters after an MPA is sited, and include lost harvest opportunities and increases in harvesting costs. However, the favorable spillover effects from an MPA can outweigh the costs, resulting in positive net economic benefits. And, because it is still unclear what the biological effect in the nonprotected area will be, it is unknown what the net effect will be.

Again, the answer depends in large part upon the biological and economic linkages between the refuge and fishery areas. Siting an MPA in an open system provides the greatest opportunity for spillover effects to outweigh economic losses from the reduction in fishable waters. However, if the protected area is too "porous," then the biological improvements within the area will not be fully realized, because the species will spend very little time within the boundary of the MPA.

In fact, our research shows that the circumstances most likely to generate broad biological benefits at the lowest costs to fishermen are those in which the protected area is moderately porous and the system has been dramatically overexploited. In these circumstances, the fishermen have the least to lose from the closure and the biological system has the most to gain through spillover effects. Our research results show more generally the

importance of considering both economic and biological factors in siting reserves. The fact is that reserve siting will not be decided on purely biological criteria. Instead, decisions will be made in a political arena, reflecting biological and economic tradeoffs, and influenced by perceptions about costs and benefits by various stakeholder groups.

While the biological link between the MPA and the larger fishery (remaining open areas) is important to determining the net effects, the response by the fishing industry is just as significant. If the industry responds to the no-take zones by fishing more intensely in the areas that are still open, these regions could be turned into barren swaths of marine environment, weakening the case that MPAs had a positive effect on the entire marine habitat. Gaining a better understanding of how the fishing industry will respond is critical to predicting the expected net effects from MPAs.

Policy Considerations

Many advocates claim that MPAs provide a hedge against fishery management failures and, therefore, MPAs make sense as a precautionary approach. In fact, MPAs can provide a degree of spatial protection to a fraction of total fish stocks; the degree of the protection depends on the openness of the system. If poor stock assessments and/or inadequate political will to set total allowable catches at biological and economic sustainable levels are the leading causes of fishery collapses, then MPAs might be a good hedge against management failures.

However, the fact that most marine environments are open and susceptible to broad oceanographic shocks, such as those caused by El Niño, may reduce the degree of protection provided the stock or the quality of the hedge. In addition, if there is little or no enforcement and monitoring of the protected area, then the expected ecological benefits will most likely go unrealized. While MPAs might provide short-term protection in certain settings, the combination of the openness of the marine environment, stock mobility, and the response by the fishermen appear to increase the long-run uncertainty associated with using MPAs.

What role should protected areas play in fishery regulation of the new century? MPAs seem particularly important as an instrument to ensure that special treasures, like unique habitat and biodiversity, are preserved for posterity. MPAs also have the potential to provide a margin of safety and perhaps even enhance the productivity of some fisheries. But their usefulness as a fisheries management tool to mitigate the ills of overfishing is less clear. Fisheries are common property resources and individual users of the resource do not face proper incentives to conserve the stock. While MPAs might provide a safety buffer under certain circumstances, they are still addressing a symptom and not the fundamental cause of overfishing and waste in fisheries. Until institutions are designed that change the incentives fishermen experience, policymakers will continue to face the overcapacity problems that have given rise to the recent momentum for increasing the scale and scope of MPAs.

James Sanchirico is a fellow in RFF's Quality of the Environment Division. This article is based on ongoing research being conducted with James E. Wilen, Ph.D., Department of Agricultural and Resource Economics, University of California, Davis. More information on RFF's research efforts in this area can be found on our Web site at *www.rff.org/ nat_resources/fisheries.htm.*

How Much Is Too Much?

Thoughts About the Use of Risk Assessment for Countries In Transition and the Developing World

Ruth Greenspan Bell and James Wilson

Risk assessment has proven to be a valuable tool in setting U.S. environmental policy. However, its use in countries with weak regulatory institutions and fundamental environmental problems is questionable, unless consideration is given to the strength and competence of the country's regulatory institutions to carry out recommendations that derive from such analyses.

The success of risk assessment as a tool for environmental decisionmaking in the United States has encouraged experts to recommend it for use in countries in transition and the developing world. With the end of the Cold War, the countries of Eastern Europe and Central Asia began to ask for help in solving their centuries of accumulated problems. It was hardly surprising that Americans would proffer their best tools. For example, the World Bank and the U.S. Agency for International Development use risk assessment and comparative risk assessment when setting priorities. Local experts are increasingly using these tools as well.

The magnitude of environmental problems facing most of these countries, as well as the persistent weakness of their environmental institutions, leads us to question whether countries still at the level of very basic environmental policy choices are well served when they are encouraged to undertake sophisticated risk assessment procedures. Formal risk assessment, as practiced in the United States, features written descriptions of the risk-creating situation being analyzed, the assumptions and methods of analysis used to reach conclusions, any uncertainties regarding those conclusions, and recommendations for action based on the existing legal and regulatory structure.

Based on a short review of why and when risk assessment is used in Western countries, as well as the environmental conditions in the countries in transition, we ask here whether full-blown risk assessment is the best way for countries with weak institutions and very basic problems to identify their priorities. We believe that sophisticated risk assessments are not useful in such contexts. They often recommend the wrong activities from a practical point of view, and often yield irrelevant results because they ignore institutional issues. In this sense, they represent a misplaced use of scarce resources.

Much cruder methods will often do. If risk assessment is to be used, we believe an important part of the analysis should include a careful consideration of the capacity, ability, and will of these countries to accept the recommendations that derive from such analysis. Analyzing the strength and competence of a country's regulatory institutions is not normally a component of risk assessment practice in countries with weak regulatory regimes, but we think it should be.

Evolution of Risk Assessment in the United States Over the Past 50 Years

Risk assessment as it is practiced in the United States is closely connected with the existence of institutions and a level of economic development not commonly found elsewhere in the world. The art and science of policy analysis, of which economic and risk analyses are a part, have evolved over the last half-century to serve the kinds of decisions American circumstances require. Most importantly, these conditions include working systems of laws and effective and functioning regulatory agencies.

With these institutions in place, the U.S. government began in the middle of the 20th century to address an environment degraded by many years of industrial activity, careless municipal waste disposal, and uncontrolled vehicle emissions. It soon became clear that some problems were easy to diagnose and solve, but others were more difficult. For example, the problem of a Potomac River made unswimmable by raw sewage was not a hard one to solve, in principle, at least. Sewers had to be built, connected to each other, and their contents treated before the water was released back into the Potomac. Once the political will was found and money was appropriated, the technical problems associated with designing, building, and operating the treatment system were ones that engineers could happily solve. Solving this problem did not take a complex risk analysis, or a sophisticated cost-effectiveness analysis.

A more difficult problem emerged in the early 1970s: the presence of very small amounts of a possible cancer-causing agent in the U.S. beef supply. "DES," the culprit, was a growth-enhancing hormone analogue used as a feed additive. The U.S. Food and Drug Administration (FDA) could not ban use of DES without eliminating beef from American diets for years. Nor could the agency ignore its presence. According to the Delaney Clause, a 1958 food safety provision that set a zero-risk cancer standard in foods for humans, there must be "no residue" of any carcinogenic substance in meat, among other provisions. And so FDA invented a new decision method, based on the theory that the risk posed by some infinitesimally tiny amount of DES could be negligible.

By the mid-1980s, efforts were under way to address basic environmental issues. The remaining problems were more subtle and difficult, their risks less clear, their costs apparently higher, and the benefits of investing in them not necessarily obvious. Risk analysis, adapted from FDA's approach to DES, has helped environmental policymakers judge the utility of different solutions to these more complex problems.

The use of chlorine gas to disinfect drinking water provides a good example. Chlorine gas is cost-effective and has a key advantage over other methods: a microbicidal residue remains in the water hours after treatment, suppressing microbial growth in long distribution pipes. However, using chlorine gas also presents risks: chlorine stored in quantity can be very dangerous, and chlorinating raw water that contains large amounts of organic matter will generate chloroform and other chlorinated by-products that may cause cancer. Water utilities found that by filtering raw water before chlorinating it, they could greatly reduce, although not wholly eliminate, formation of by-products. Some risk from exposure to these by-products therefore remains. But over the past few years, the U.S. Environmental Protection Agency has used a sophisticated risk analysis to conclude that, at present levels, these by-products pose a negligible risk, and so use of chlorine for water treatment should continue.

In addition to risk assessment that asks how many illnesses might occur as a result of exposure to some substance, risk assessment also has been used to compare different kinds of risks in order to set regulatory or budget priorities. A significant recent change in the use of risk-based tools in the United States is the inclusion of affected publics in the risk-assessment process. This shift represents a response to public criticism and an evolution from a scientific exercise to one that more broadly addresses the needs of both policymakers and the public.

From one side, community-based activists lambasted risk assessment for not generating useful information and being technically indecipherable. And from the other side, those who bore most of the costs of cleaning air, water, and land blasted it as rigid and biased. This discontent found expression first in vocal criticisms of the Superfund program and U.S. Department of Energy practices. It was given intellectual respectability by a series of reports published in the mid-1990s by several National Research Council (NRC) committees and the Commission on Risk Assessment and Risk Management, which was established under the 1990 Clean Air Act Amendments. These committees essentially called for modifying the FDA-based way of doing complex risk assessment to address these issues and increase participation by ensuring greater inclusiveness and openness with respect to the preparation of the analysis and its use.

In the United States today, risk assessment is increasingly

regarded as a means for translating the best available scientific information about risk into language that assists open and public processes for environmental decisionmaking. In democracies, public consent is recognized as a necessary element in setting effective environmental policy. Moreover, experts recognize that many of the judgments made within the risk assessment exercise reflect subjective decisions closely related to public values.

Marked Differences in Environmental Conditions and Institutional Contexts

Environmental conditions in many countries in transition and in the developing world are markedly different from those in the United States. Heavy emphasis on industrialization in the former Soviet bloc left extensive damage, which has been documented at length by the World Bank, the U.S. government, and numerous independent experts. Russian environmental leader Alexey Yablakov has described his own country in this way: "if we compare the planet with a communal apartment, we occupy the dirtiest room." According to observers such as the U.S. Department of State, a harmful by-product of China's rapid industrial development in recent years has been increased air and water pollution, which will be a serious problem in China for years to come.

The institutional context for environmental policymaking in countries in transition and the developing world also differs from the United States. Although environmental laws are on the books, most of these countries have not yet put basic environmental controls in place. In some, the use of law to address such problems is not a tradition. In others, enforcement is weak or nonexistent, regulatory systems are frail at best, or the level of government commitment is uncertain. Russian critics have been very vocal about their disappointment in the performance of the Russian State Committee for Environmental Protection. Yablakov has said, "One gets the impression that [the committee] is just treading water. It adopts a whole load of good programmes on lead, on dioxins—but doesn't carry them through. Not even a quarter of them come to fruition, less than a tenth do."[1] Now even this weak institution has been closed down. In May, President Putin of Russia signed a decree abolishing the State Committee, which had already been downgraded from a ministry several years before by President Yeltsin.

Are these the right conditions for the use of complex risk assessment or other environmental priority-setting tools? Tools to inform policy decisions presume an ability to use these to carry those decisions out and a willingness to act. Risk assessment in the United States primarily is used to guide policy, and the entire process is predicated on "rule of law" with institutions that have adequate expertise and power to carry through the recommendations that result. Without this ability to follow through, we worry that risk assessment will be purely a paper exercise that will divert much-needed resources.

Countries such as Russia and China certainly do not lack people with the skills to do sophisticated risk assessments. On the contrary, scientists with world-class skills and training are found in many parts of the transitioning and developing world. This is the irony of our observation: the professional skill base tends to lead in a direction that many countries are incapable, at present, of following.

Some will argue, quite correctly, that these are countries with limited resources for environmental protection and difficult choices to make. Comparative risk analysis would seem to be an ideal tool under these circumstances. In our view, there is no question of the strength of risk assessment to help policymakers sort through where investments will make the most difference. We are not arguing that some rough forms of analysis are unnecessary. But problems in developing countries tend to be more like the conditions that led to cleanup of the Potomac River sewage problem than they are like the conditions that led to concerns over small residues of chloroform in drinking water. In most cases, a "back of the envelope" analysis, whether of specific or relative risk, will be adequate. That is, instead of a formal risk assessment, it often will be quite adequate simply to identify the most significant sources of environmental pollution and then analyze institutionally and economically viable ways to reduce releases.

Most importantly, the information derived from risk assessment can be illusory without explicit incorporation of the institutional realities within which the decisionmakers work. For example, in the early 1990s, the Peruvian government received warnings about the possible cancer hazard posed by chlorinating drinking water. The government stopped chlorinating the water and a cholera epidemic ensued. Given the existing infrastructure in that country, it was a huge mistake to have tinkered with what was clearly working.

Our concern about the mismatch between intellectual and institutional capabilities in the developing countries leads us to suggest that perhaps "worst things first" is not a sensible doctrine. Principally, these are places where tackling the most difficult

problems requires a level of regulatory experience, infrastructure, and government support that simply does not exist. We suggest that in these settings, the pragmatic approach would be to focus on solving lesser problems that will generate regulatory experience and "lessons learned," to be applied over time to more complex problems. We recognize that this may be less orderly than many would like, but it may well be more effective in the long run.

We also suggest that promoting the use of technical tools such as risk assessment may unknowingly reinforce the tendency in many countries to treat environmental protection as a purely technical exercise engaged in only by experts. A common weakness in the environmental protection regimes of former Soviet bloc countries is a tendency to make decisions about environmental policy based entirely on presumed "science," with minimal, if any, public outreach. Consequently, little effort is spent determining whether adequate support exists in society for reaching the standards that experts recommend.

Experienced observers of the Russian system of environmental protection, such as Laurence Mee, former coordinator of the Global Environment Facility's Black Sea Environmental Project, have asked whether Russian priorities stem from a way of thinking that has been in vogue in Russia and the Soviet Union for the last fifty years or so, namely a focus on seeking the technological "quick fix." Mee contends that Western aid tends to reinforce the idea that everything can be fixed with technology, thus undermining efforts to change public attitudes.[2] From what we have seen of risk analysis done in these contexts, we have to agree.

Policymaking in the countries in transition and the developing world should not occur in a vacuum. In our view, to be effective, risk assessment must be tailored to the circumstances at hand. Experts need to go the extra mile, to contribute more than a narrow technical expertise to the consideration of these critical problems so central to the health and welfare of real people. Without this recognition, risk assessment will be divorced from the genuine needs of the very societies that it seeks to influence.

Ruth Greenspan Bell is a visiting scholar and James Wilson is a senior fellow in RFF's Center for Risk Management.

[1] John Massey Stewart, *Environment: Working With Russia, The Ups and Downs of International Environmental Collaboration* (Part I), Central European Review, Vol. 1, No. 12 (Sept. 12, 1999), (www.ce-review.org/99/12/stewart12.html).

[2] Ibid.

Balancing Policies for Energy Efficiency and Climate Change

Richard G. Newell

While improving energy efficiency through technology offers a significant opportunity to reduce greenhouse gas emissions, the best means for reaching climate policy goals may be by creating market incentives that encourage the development and use of climate-friendly technologies in general.

Decisionmakers responsible for climate change policy must address challenging questions and face competing goals when setting priorities. Changes in greenhouse gas (GHG) emissions can be driven by a number of factors, including shifts in population, economic activity per capita, energy use per unit of economic activity (energy efficiency), and the carbon intensity of energy used (carbon efficiency). To change emissions, decisionmakers must consider a number of policy options, which can vary greatly in their cost and effectiveness.

Limiting economic activity as a means of reducing GHG emissions has scant political appeal for rich countries, let alone poor ones. Technological improvements that generate enhanced energy and carbon efficiency have therefore been the principal means discussed for addressing climate change. Recent policy proposals have, for example, included tax credits for the purchase of energy-efficient equipment, public-private partnerships aimed at developing and deploying energy-efficient technologies, and energy-efficiency standards for products.

Energy efficiency is often regarded as a goal unto itself. Politicians, government officials, and the public have embraced energy efficiency perhaps because it is relatively tangible and accessible. However, it is important to sound a note of caution about viewing direct control of energy efficiency per se as a primary means for meeting climate policy goals. Policy initiatives should be directed toward supporting efforts aimed at addressing problems—such as the environmental externality of global climate change and inadequate information on technological opportunities—where the marketplace will not or has not operated effectively.

The path of technology development and diffusion through the marketplace is complex and uncertain. To better comprehend it, we will consider the cost of improving energy efficiency to limit GHG emissions; the "energy-efficiency gap" that occurs when the marketplace does not adopt the most energy-efficient technologies available; typical patterns for technology invention, innovation, diffusion, and use; and finally, implications for climate change policy.

Making Energy Efficiency More Cost-effective

The importance of energy efficiency in limiting GHG emissions is not in question; however, there is intense debate about both its cost effectiveness and the government policies that should be pursued to enhance energy efficiency. Essentially, there are two sides to this argument.

"Technologists" (our shorthand term) are those who believe there are plenty of opportunities for low-cost, or even "negative-cost," improvements in energy efficiency. In their opinion, realizing these opportunities will require active intervention in markets for energy-using equipment to overcome barriers to the use of more efficient technologies. This view implies that with the appropriate technology and market creation policies, significant GHG reduction can be achieved at very low cost.

Most economists, on the other hand, acknowledge that there are "market barriers" to the penetration of technologies that enhance energy efficiency, but that only some of these barriers represent real "market failures" that reduce economic efficiency. There are tradeoffs between economic efficiency and energy efficiency, according to the economic perspective. It is possible to get more of the latter, but typically only at the cost of less of the former. GHG reduction is therefore more costly than the technologists argue. Economists also tend to put more emphasis on market-based GHG control policies, such as carbon taxes or tradable carbon permit systems, to encourage the least costly means of carbon efficiency (not necessarily energy efficiency) enhancement available to individual energy users.

Although energy and technology markets certainly are not perfect (no markets are), the balance of evidence supports the view that there is less "free lunch" in energy efficiency than some have suggested. Nonetheless, a case can be made for the existence of certain inefficiencies in energy- technology markets, thus raising the possibility of some inexpensive GHG control through energy-efficiency enhancement.

Understanding the "Energy-efficiency Gap"

Many analysts contend that an "energy-efficiency gap" exists between the most energy-efficient technologies available at some point in time and those that are actually in use. However, the extent to which there are low-cost or no-cost options for reducing fossil-fuel energy use through improved energy efficiency remains open to debate. Economists and technologists involved in setting climate change policy have different views of this energy-efficiency gap. Their split is about whether and to what degree the gap is the result of market failures that might be amenable to policy intervention or simply market barriers that would be surmountable only at relatively high cost.

To understand the basic elements of this debate, it is helpful to distinguish first between energy efficiency and economic efficiency. Consider two air conditioners that are identical except that one has higher energy efficiency and, as a result, is more costly to manufacture because high-efficiency units require more cooling coils, a larger evaporator, and a larger condenser, as well as a research and development effort. Whether it makes sense for an individual consumer to invest in more energy efficiency depends on balancing the value of energy saved against the increased purchase price, which is based on the value of the additional materials and labor spent to manufacture the high-efficiency unit. The value to society of saving energy should also include the value of reducing any associated environmental externalities, such as air pollution.

Adoption of more energy-efficient technology will not always enhance economic efficiency. It is possible to simultaneously increase energy efficiency and economic efficiency; this will be the case if there are market failures that impede the efficient allocation of society's energy, capital, and knowledge resources in ways that also reduce energy efficiency. When people speak of "no-cost," "win-win," or "no regrets" climate policies based on energy-efficiency enhancement, they are often implicitly or explicitly assuming the presence of market failures specifically in energy efficiency (as opposed to environmental externalities). Some of these are noncontroversial, such as inadequate private sector incentives for research and development, and information shortages for purchasers regarding the benefits and costs of adopting more efficient equipment.

Other more controversial market failures include: the extent to which investment in energy efficiency is limited because of financing constraints; the degree to which there are market failures because landlords rather than tenants pay utility bills; and the possibility that businesses do not pursue potentially rewarding energy efficiency investments because their managers are not adequately rewarded. Even where market failures exist, however, not all market failures can be eliminated at an acceptable cost. In cases where implementation costs outweigh the gains from corrective government intervention, it will be more efficient *not* to attempt to overcome particular market failures.

In contrast to the economists, technologists have focused on a simple "engineering-economic" model. The technologists' definition of optimal energy efficiency is found by minimizing the total purchase and operating costs of an investment, where energy-operating costs are discounted at a rate the technologist (not necessarily the purchaser) feels is appropriate.

However, the problem with this approach is that it does not accurately describe all the issues that can influence energy-

efficiency investment decisions. First, the importance of certain factors can vary considerably among purchasers, including the purchaser's discount rate, the investment lifetime, the price of energy, the purchase price, and other costs. For example, it may not make sense for someone who will only rarely use an air conditioner to spend significantly more purchasing an energy-efficient model; there simply may not be adequate opportunity to recoup the investment through energy savings.

Second, the technologists' engineering-economic analysis typically does not account for changes over time in the savings that purchasers might enjoy from an extra investment in energy efficiency, which depends on trends and uncertainties in the prices of energy and conservation technologies. When making irreversible investments that can be delayed, such as the purchase of air-conditioning equipment, the presence of this uncertainty can lead to a higher investment-hurdle rate. The magnitude of this "option-to-wait" effect depends on project-specific factors, such as the degree of energy-price volatility, the degree of uncertainty in the cost of the investment, and how fast energy and conservation technology prices change over time.

Finally, there is evidence that energy savings from higher efficiency levels have routinely been overestimated, partly because projections often are based on highly controlled studies that do not necessarily apply to actual, realized savings in a particular situation. For example, studies have found that actual savings from utility-sponsored programs typically may achieve only 50% to 80% of predicted savings. Another study found that the actual internal rate of return to residential energy conservation investments on insulation was about 10%, which is substantially below typical engineering estimates that the returns for such investments would be 50% or more.

Requiring consumers to purchase appliances with a higher level of efficiency based on a simplistic analysis could, in effect, impose extra costs on consumers. The result might be a higher level of energy efficiency but decreased economic efficiency, because consumers could be forced to bear costs that they had otherwise avoided.

Invention, Innovation, Diffusion, and Use

To understand the potential for public policy to improve energy efficiency, it is necessary to understand that technology evolves through a process of invention, innovation, diffusion, and product use. Policies can affect each stage of this process in specific and different ways. Invention involves the development of a new idea, process, or piece of equipment. The second step is the process of innovation, in which new processes or products are brought to market; another term for this stage is commercialization. The next step is diffusion, the gradual adoption of new processes or products by firms and individuals, who then also decide how intensively to use new products or processes. In this context, the energy-efficiency gap essentially is a debate about the gradual diffusion of energy-saving technologies that at least appear to be cost-effective.

An example of invention would be a fundamentally new kind of automobile engine that could serve as an alternative to the internal combustion engine, such as a system dependent upon fuel cells. The innovation step would be the work carried out by automobile manufacturers to bring this new engine to market. The diffusion process, then, would reflect the purchase by firms and individuals of automobiles with this new engine. Finally, the degree of use of these new automobiles would be of great significance to the demand for particular types of energy, which, in turn, would affect GHG emissions.

The reason it is so important to distinguish carefully among these different conceptual steps—invention, innovation, diffusion, and use—is that public policies can be designed to affect various stages and will have specific effects. Economic incentives and conventional regulations can be targeted to any of these stages, but with varying degrees of success. The rate or speed of invention (increased energy-related patent applications), innovation (commercialization of more energy-efficient products), and diffusion (greater penetration of energy-efficient technologies) tends to be higher when energy is more expensive. Although the methods used to demonstrate and measure this link are complex, the underlying phenomenon makes common sense. Manufacturers develop products to meet consumers' desires, and consumers (be they individuals or firms) will want greater energy efficiency when energy is more expensive. The same reasoning would apply to carbon emissions—if they had some price.

While a substantial amount of innovation in the energy efficiency of products we have investigated resulted simply from the passage of time, changes in energy prices and energy-efficiency standards had significant effects. Energy price changes induced both commercialization of new models and elimination of old models. And introduction of energy-efficiency standards required manufacturers to stop manufacturing certain less-efficient products.

The typical pattern for technology diffusion is for a given technology to be gradually adopted, with the pace picking up over time. At some point, the technology becomes saturated in the economy, and adoption slows down; a good example of this phenomenon would be cellular telephones, which are much earlier in the diffusion process than, say, clothes washers or televisions. The explanation for this typical diffusion path that has most relevance for energy-conservation investments relates to differences in the characteristics of adopters and potential adopters. These differences include the type and vintage of existing equipment; access to as well as the cost of labor, materials, and energy; and access to technical information.

The investment return from adopting a given technology will vary from one individual to another; as a result, only potential adopters for whom it is especially profitable will adopt at first. Over time, however, more and more will find it profitable as the cost of the technology falls, its quality improves, information about the technology becomes more widely available, and existing equipment stocks depreciate.

Implications for Climate Change Policy

Government officials trying to determine an appropriate course of action regarding energy conservation must ultimately decide on their primary policy objective: economic efficiency (including environmental externalities) or energy efficiency. Technological studies that demonstrate the existence on the laboratory shelf of particular energy- or carbon-efficient technologies are a useful first step, but they are not sufficient to address important policy questions. It is necessary to examine whether and how specific policies will affect the processes of invention, innovation, diffusion, and intensity of use of products, and how much these policies will cost.

One factor clearly influences the development, adoption, and diffusion of technology, according to our research. Economic motivations—operating directly through higher energy prices and falling costs of technological alternatives due to innovation—are effective in promoting the commercialization, market penetration, and use of more energy-efficient, GHG-reducing technologies. Policies that support the effects of these direct market signals also can be useful; these include subsidies for basic research and development to compensate for an imperfect patent system, reform of energy-sector regulation, reduction of subsidies that encourage uneconomic energy use, and provision of information about product attributes and new technological opportunities.

Energy-efficiency improvements certainly can be relevant for climate policy; however, it is also important to remember that primary fuels differ substantially in terms of their GHG emissions per unit of energy consumed. Policies focused on energy use rather than GHG emissions run the risk of orienting incentives and efforts in a direction that is not cost-effective. In particular, policies focused on energy efficiency ignore the other important way in which GHG emissions can be reduced—namely, by reducing the carbon content of energy.

Economists generally prefer to focus policy instruments directly at the source of a market failure. Policies focused on carbon emissions—such as tradeable carbon permits or carbon fees—will provide incentives for conserving particular fuels in proportion to the fuels' GHG content. For example, these policies would raise the price of oil by a higher percentage than the price of natural gas, thereby targeting incentives for energy-efficiency improvements to oil-fired furnaces relatively more than to gas furnaces. In addition, policies focused on GHGs rather than energy per se, would also provide incentives for the purchase of gas rather than oil-fired furnaces.

Market failures may be caused by other factors besides the environmental externality of global climate change associated with energy-efficiency investments; the most salient factor is that purchasers potentially lack information about the value and cost of energy efficiency. If the magnitude of these non-environmental market failures is large enough and the cost of correcting them small enough to warrant policy intervention, an argument can be made for attacking these other market failures directly. Any attendant reduction in GHGs can then be viewed as a bonus; this line of argument is often used by proponents of energy-efficiency policy in the context of climate change policy discussions. Therefore, it becomes crucial to investigate the magnitude of these other market failures and to assess which policies would be most cost-effective in addressing them. There is a need to emphasize policies that create clear incentives for changes in energy use and technology by raising the price of GHG emissions, as well as targeting those informational market failures that do represent opportunities for cost-effective improvements in market performance.

Richard G. Newell is a fellow in RFF's Energy and Natural Resources Division. This article is based on a longer paper he co-authored with Adam B. Jaffe and Robert N. Stavins. "Energy-efficient Technologies and Climate Change Policies: Issues and Evidence" can be found on RFF's Web site devoted to climate change issues, *www.weathervane.rff.org*.

RFF Honors Terry Davies for Influential Role in Environmental Policymaking

RFF held a celebration in early May to honor J. Clarence "Terry" Davies, director of the Center for Risk Management and a senior fellow, who is retiring. Davies, a political scientist whose career spans more than 35 years, has played an influential role in the development of this country's environmental regulatory system.

RFF invited William Ruckelshaus, the first administrator of the U.S. Environmental Protection Agency (EPA) and former CEO of Browning-Ferris, to comment on Davies' many accomplishments and contributions. Ruckelshaus has known Davies for many years.

"It is not an exaggeration to say that Terry Davies is as responsible as anyone for laying the foundation for environmental public policy in this country," Ruckelshaus said. Davies' career is remarkable in its breadth and scope — he co-authored the reorganization plan that established EPA and went on to help draft several major pieces of legislation, including the Toxic Substances Control Act (TSCA), Ruckelshaus said.

William Ruckelshaus

"Throughout his career, Terry has taken on landmark, path-finding assignments," Ruckelshaus said. Between teaching stints at Bowdoin College and Princeton University, Davies became the very first budget examiner for environmental programs at the Bureau of the Budget. He then went on to serve as a consultant to the President's Advisory Council on Executive Organization, where he played an important role in developing the plan for organizing parts of 15 different agencies from across the federal government into an entirely new agency — EPA.

Davies subsequently served on the senior staff of the Council on Environmental

Terry Davies

Quality and as executive vice president of the Conservation Foundation. And from 1989 to 1991, he was the EPA assistant administrator for policy, the agency's third-ranking position. In 1992, he rejoined the RFF staff, where he had spent a three-year stint in the mid-1970s.

"Terry was present when the fundamental set of laws that have formed the framework for environmental policy in this country were created," including the Clean Air Act, the Clean Water Act, and TSCA, Ruckelshaus said. Since then, he has spent much of his time "serving as a constructive, objective critic of the laws he helped to put into place," Ruckelshaus said.

"Over the past 20 years, there has been virtually no committee or group that has tried to look comprehensively at the base of our environmental laws, that Terry hasn't been part of," Ruckelshaus said. Davies was a member of the National Academy of Public Administration's Committee on EPA Priorities, and has served on or chaired numerous EPA and National Research Council committees.

Davies has published several books and numerous articles over the years. His research has included work on risk assessment and risk management issues, pollution control regulations, public participation in environmental decisionmaking, program evaluation, and the use of science in environmental decisions.

"Terry's contribution to the understanding, maturation, and development of our environmental regulatory system has been huge," Ruckelshaus said.

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Former EPA Administrators William D. Ruckelshaus and Russell E. Train, and former EPA Deputy Administrator F. Henry Habicht II, who also serves on the RFF Board of Directors.

Terry Davies and family

INSIDE RFF

RFF Welcomes New Director for the Center for Risk Management

Michael R. Taylor has been appointed the new director of RFF's Center for Risk Management. Taylor, a lawyer who has held senior policy positions at the U.S. Food and Drug Administration (FDA) and the U.S. Department of Agriculture (USDA), succeeds J. Clarence (Terry) Davies, who retired in May.

In addition to guiding the Center's future activities, Taylor will serve as a senior fellow and develop a research program on policy and institutional issues that affect the success of the global food and agricultural system. He will focus on food security, food safety and nutrition, environmental protection, and conservation of natural resources.

"I am delighted to be joining RFF, especially now, when its rigorous research and objective analytical work are needed more than ever to address pressing public issues," Taylor said.

Prior to coming to RFF, Taylor was Vice President for Public Policy at Monsanto and a partner in the Washington, D.C., office of King & Spalding. In addition, he served as Administrator of the USDA Food Safety and Inspection Service from 1994 to 1996, as FDA Deputy Commissioner for Policy from 1991 to 1994, and as Executive Assistant to the FDA Commissioner in 1980. He is an adjunct professor of law at Georgetown University Law Center, and received his law degree from the University of Virginia.

"Mike's extensive experience in public health regulation as well as with aspects of the policy process—both as a practitioner and scholar—will make him a tremendous asset," RFF President Paul Portney said.

Analysts at the Center for Risk Management carry out a multi-disciplinary program of research, policy analysis, and outreach related to human health and the environment.

SYLVIA JOHNSON PHOTOGRAPHY

Michael R. Taylor

New RFF Fellow

Sandra A. Hoffmann has recently joined the staff of RFF's Center for Risk Management. She comes to RFF from the University of Wisconsin, Madison, where she held a joint faculty position in the La Follette Institute of Public Affairs and the Department of Urban and Regional Planning.

At RFF, Hoffmann will work on both the law and economics of environmental management and agriculturally related environmental policy issues. In the law and economics area, she plans to focus on the interaction of regulation and private suits for environmental damages as environmental management tools.

Hoffmann received a Ph.D. from the University of California, Berkeley, Department of Agricultural and Resource Economics, and a J.D. from the University of Maryland Law School. She also has an M.A. from the University of Wisconsin, Madison's Department of Agricultural Economics. Before pursuing her Ph.D., she practiced law with the Washington, D. C., office of McKenna, Conner, and Cuneo, specializing in regulations governing pesticide and chemical manufacturing.

SYLVIA JOHNSON PHOTOGRAPHY

Sandra A. Hoffmann

RFF Visiting Scholar Receives Honorary Degree

The University of St. Gallen (Switzerland) has awarded RFF Visiting Scholar **Wallace E. Oates** an Honorary Degree of Doctor of Economics to honor his achievements in the development of economic theory, particularly as it pertains to the environment and the theory of fiscal federalism.

The text of the honorary degree reads: "In his research, he has always aimed to contribute not only to academic debate—which he has influenced decisively—but also to political practice. He has thus demonstrated in exemplary fashion how theoretical research of high quality can aid the solution of practical problems."

INSIDE RFF

Fellowship and Internship Award Winners

RFF awards annual internships in honor of Walter O. Spofford Jr. As founder of RFF's China Program, Spofford helped to establish the Beijing Environment and Development Institute. His seminal work with Chinese officials contributed to the formation of environmental standards compatible with sustainable economic growth.

To continue work in this important arena, RFF has awarded **Xuehua Zuang** with this year's Walter O. Spofford Jr., Memorial Internship Award. At RFF, Xuehua will work with researchers on various aspects of environmental protection in China, including issues regarding institutional development.

Xuehua is working towards her master's degree in geography, focusing on enforcement issues in China's environmental policies, in the Center for Geography and Environmental Social Science at Western Washington University.

In honor of Gilbert F. White, retired chairman of the RFF board of directors, distinguished geographer, and statesman of science, one resident fellowship has been awarded to **Allan Mazur**, political scientist and professor at the Maxwell School at Syracuse University.

Mazur will join RFF in the fall to analyze how the media, scientists, and the public have communicated and responded to risk over the past couple of decades. He plans to analyze several public warnings that were raised during the 1950s and 1960s about possible environmental and technical hazards to determine hallmarks that might distinguish whether the warnings were real hazards or false alarms.

Allan received his B.S. degree in physics from the Illinois Institute of Technology, his M.S. in engineering (astrodynamics) from the University of California, Los Angeles, and his Ph.D. in sociology from Johns Hopkins University.

RFF awards fellowships every year in support of doctoral dissertation research on issues related to the environment, natural resources, and energy in honor of Joseph F. Fisher, RFF president from 1959 to 1974. The fellowships are intended to be the principal support for graduate students in the final year of their dissertation research. Congratulations to the following recipients:

Paul Ferraro, currently attending Cornell University in the Department of Agricultural, Resource, and Managerial Economics, is assessing the potential of conservation performance payments to transform the way in which environmental assets are conserved globally.

At Yale University's Department of Forestry and Environmental Studies, **Aarti Gupta** is examining national and transnational governance regimes for the safe use of biotechnology in agriculture.

Tanya A. Heikkila, from the School of Public Administration and Policy at the University of Arizona, seeks to explain the development and implementation of the coordinated use of ground and surface water supplies in Arizona, California, and Colorado.

Nathaniel Keohane has been studying the effect of SO_2 trading on technological change in pollution control at the Kennedy School of Government at Harvard University.

Currently attending the University of Michigan within the Department of Political Science, **Kristin Kuntz-Duriseti**'s research attempts to frame the relationship between economic growth and potential climate damages.

Monica Nevius, from the University of Wisconsin, Madison's Department of Sociology is researching sociological factors that might determine certain patterns of energy use, such as family size and wealth.

Studying at Duke University's Department of Economics, **Randy Walsh** is analyzing the relationship between private and public open space and private residential demand for land, and the implications of different open space policies on land price.

Karl Wunderlich, from the Graduate School of Public Affairs at the University of Colorado in Boulder, is examining the effectiveness of local land trusts in protecting key parcels of land in the face of urban sprawl and habitat loss.

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Environmental Constraints on Electricity Generation and the Role of Natural Gas

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For more information, please contact Russell Ray at 202-328-5154 or ray@rff.org

DEVELOPMENT

An open letter to our friends and donors

I recently celebrated my first anniversary at RFF and my tenth anniversary in the field of development. Two questions I am frequently asked are, "What do you enjoy most about RFF?" and "Why, in heaven's name, *fundraising*?" The answer to both is very simple: it's an honor to work with the Board and staff of a world-class environmental research institution like RFF, which is highly regarded and supported by people like you.

Over the past year, I've had the great pleasure of getting to know many of RFF's volunteers, donors, and friends, especially our Council members who actively participate in the intellectual life of RFF. However, there are many, many more loyal contributors and *Resources* readers whom I've yet to meet. I wanted to take this opportunity to extend my personal thanks to you for your interest in and continued generosity to RFF.

RFF's successful development effort can be traced back to the late 1970s when the Ford Foundation, which provided funding to RFF for its first 27 years, encouraged us to become financially independent. RFF's Board and staff members—including people like Emery Castle, Gilbert White, M. Gordon "Reds" Wolman, Hans Landsberg, and John Krutilla—raised $7 million to match Ford's challenge. This $14 million formed the nucleus of our current endowment fund.

Currently, RFF raises almost 25% of its annual budget from contributions—the unrestricted gifts we receive from individuals and corporations account for almost 20% of annual expenses, and foundation grants for a mere 5%. Over the coming years, we expect these numbers to increase dramatically—with individuals and private foundations becoming more important sources of revenue.

SYLVIA JOHNSON PHOTOGRAPHY

Lesli A. Creedon, Director of Development

Why?

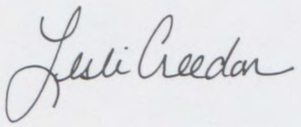
Because, over the past two years, RFF scholars—working together with Board members and representatives from the academic, corporate, government, and environmental advocacy communities—have been defining new areas of research on which to focus our efforts in the future. The issues we have identified (the impacts of technology and the environmental and health problems of the developing world, to name just two) are on the forefront of our country's and the world's policy agendas. By focusing on the most critical policy issues, awareness of RFF is higher than ever. Our research is reaching a wider and more diverse audience than ever before and is being recognized and utilized by growing numbers of policymakers, business and foundation executives, environmental advocates, journalists, academics, and concerned citizens. Both their interest and financial support represent an overwhelming vote of confidence in our work.

Unlike many other people who wander into development from other fields, I chose it as a career and begun fundraising for local nonprofits as an undergraduate at Miami University. I did so because it offers me the rewarding opportunity (and challenge!) of matching the personal interests of people like you with organizations that are doing important work. Over the past few months, I have been travelling to San Francisco, Houston, and other places where our Board members have hosted events to introduce our scholars to the "movers and shakers" in their hometowns. To see the positive reactions of people when they first learn about RFF and, for example, its very influential work on global climate policy, is rewarding and inspirational. It only reinforces my belief that RFF is *the* place to look to for top-notch research, scrupulous independence, and a commit-

ment to improved environmental policymaking worldwide.

I hope you view your relationship with RFF as a two-way street. While we rely on our friends for support and guidance on topics we should be addressing, we also hope our research helps you better understand critical environmental problems and policy questions. This fall, we will launch a new Web site with "chat room" capabilities that will allow us to communicate with you more frequently, and a strong search engine that will allow you to easily navigate the RFF database for op-eds, discussion papers, and reports by our research staff.

What do I like most about my job at RFF? Interacting with people like you who share our desire for more enlightened policymaking and, in the end, a better environment and world. I encourage you to call (202/328-5016), write, or e-mail me (*creedon@rff.org*) with your thoughts on how RFF can be a more effective organization, and how we might strengthen our relationships with concerned citizens like you. Thanks again, for your interest and support.



Lesli A. Creedon

Welcome to the RFF Council

RFF would like to thank the following corporate Council members for their generous support of our efforts to inform and influence environmental policy.

Robert A. Day
Chairman and CEO
The TCW Group, Inc.

Jane M. Hutterly
Senior Vice President, Worldwide Corporate Affairs
S.C. Johnson & Son, Inc.

SYLVIA JOHNSON PHOTOGRAPHY

Each year, RFF invites a number of students to spend the summer as research assistants. Interns can work with RFF researchers on a variety of ongoing projects, or assist in the development of entirely new areas of research and policy analysis. Pictured here are this year's interns posing with Vice President for Programs Ray Kopp.

Front row (*l to r*): Eun-Hee Kim, Anjali Bhat, Xuehua Zhang (Walter O. Spofford Jr. Memorial Intern), and Elizabeth Kopits. Second row: Heather Holsinger, Michael Schwaiger, Ray Kopp, Jianfeng Zhang, and Shannon Allen. Third row: Stephen Newbold, Joshua Mandelbaum, Darshana Patel, Yoram Bauman, and David Evans. Not pictured: Leila Polintan (Publications Intern).

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