

# RESOURCES

RESOURCES FOR THE FUTURE

RESEARCH THAT MAKES A DIFFERENCE

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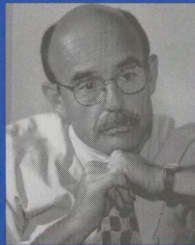
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## Looking to the Future



Paul R. Portney

**G**iven our organizational name, one should not be surprised to find a future orientation to much of the work conducted here at RFF. It's not really that we attempt to stargaze, but our scholars typically will scrutinize environmental issues with an eye to developing necessary new methodologies or to heading off policy problems before they emerge or worsen. The current issue of *Resources* is especially rich in reporting this type of activity.

In the feature article "Energy Trading—The Market's Response to Deregulation," Vito Stagliano and Sarah Emerson look at developments in the petroleum industry during the past sixteen years—particularly the emergence of futures markets—to forecast the prospects in store for Americans under much more competitive markets for natural gas and electric utilities.

If talk of change is everywhere with respect to electricity policy, it's positively thematic on the subject of climate. As discussion gradually begins to move away from natural scientific questions about climate change to possible responses, Mike Toman's "A Framework for Climate Change Policy" provides a key to use in evaluating climate risks and formulating necessary policies.

Recent regulatory changes offer the promise of a safer American food supply, according to Mike Taylor—especially if steps he identifies in "Preparing America's Food Safety System for the Twenty-First Century" are taken to help implement the new approach.

The shorter entries in the "Goings On" section also advance this forward-looking theme. A two-year RFF study of the comprehensive impacts of a proposed new dam in northern Thailand on local forest communities will develop and demonstrate methods for analyzing similar development projects throughout the world. A project measuring the economic returns from space technologies foreshadows a possibly disconcerting future world in which sophisticated "remote sensing" raises serious questions about privacy and national sovereignty. What the future holds for national air quality standards, public health, and economic vitality was the subject of a recent RFF symposium, part of our continuing involvement with this hot topic. And an RFF workshop explored ways to anticipate and account for the effects of advanced technology in reducing global greenhouse gas emissions. Finally, through our study of the contributions of technological innovation to productivity growth in U.S. natural resource industries, RFF is taking a fresh look at the adequacy of America's resources for the future.

In developing our agenda, we at RFF routinely look down the road for opportunities to focus our work on pressing social problems. Sometimes we find these roads do not yet exist. We then willingly embrace the pioneering spirit that constitutes so much of RFF's institutional heritage to cut pathways to the future. And we count on your input as regular readers of *Resources* to help us set our sights.

*Paul Portney*

## RESOURCES

### RESOURCES FOR THE FUTURE

1616 P Street, NW  
Washington, DC 20036-1400  
202-328-5000

FAX: 202-939-3460

E-MAIL: [info@rff.org](mailto:info@rff.org)

WORLD WIDE WEB:

<http://www.rff.org>

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Vice President—Finance and Administration, Edward F. Hand

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
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## Ford funds impact study of Thai dam

The Ford Foundation is providing a two-year, \$100,000 grant for RFF researchers R. David Simpson and Roger A. Sedjo to study the impact of a proposed dam in northern Thailand on local forest communities. Such an impact is not often accounted for in current development planning in the region as rising populations and growing economies in Southeast Asia create demand for more water.

The researchers will focus on determining the value of biodiversity that would be lost in the Mae Yom River valley

from flooding behind the proposed dam; the value of carbon sequestration provided by forests cut in preparation for flooding; and the value of recreation and tourism opportunities lost by destroying an old-growth forest.

Working with the research project's director, Suthawan Sathirathai of Chulalongkorn University in Bangkok, Sedjo and Simpson are assessing the total ecological, social, and cultural implications of the proposed Kaeng Sua Ten dam. They also plan to use the grant to enhance local expertise in environmental economics.

In assessing the dam's impact, the research team will

try to account for all of the related benefits and costs. Their analysis will include often-ignored, less apparent values, such as the plants, animals, and other natural features important to local communities.

Goods derived from forests that might be lost in a water development project include wood for fuel and construction; fruits, nuts, and food derived from forest plants and animals; grazing and foraging lands for domestic animals; rattan and other useful materials; and forest medicines. Crucial functions of the forests that would be lost include provision of clean water, protection from erosion, cycling of nutrients, and local climate moderation.

The RFF researchers will collaborate with local researchers. Pooling their expertise, they hope to demonstrate methods applicable to analyzing similar development projects in Thailand and other developing nations around the world. 🏡

## Valuing space technologies

RFF Senior Fellow Molly Macauley and some of her colleagues are digging into what she calls the "valuation tool kit" that RFF has developed over many years to arrive at some good ways to measure the economic return to space technologies. Funding commercial spinoffs for technologies emanating out of federal missions like military surveil-

lance is a relatively new but growing trend. Since about 1980, Congress has written legislation supporting government agencies that aim to capitalize on research and development once meant only to serve themselves.

These so-called "technology transfers" from the public to the private sector (and sometimes back again) enable Americans to keep up with industrial rivals abroad. At home, they can revitalize industries struggling to cope with the post-cold war decline in demand for their output. And they offer taxpayers some satisfaction for the dollars they've invested in science and technology.

A spectacular example of success in technology transfer is the commercial use of satellite remote sensing. Until recently, remote sensing was a tool wielded by a handful of nations to spy from outer space on the military activities of other nations. Now as many as a dozen commercial satellites, licensed to private American companies by the U.S. Department of Commerce, may go into orbit over the next decade.

For the first time, American commercial spacecraft will have the right to zero in on objects as small as an automobile and sell the resulting images to anyone who cares to purchase them. The images are estimated to cost as little as a few hundred dollars and are foreseen to have many purposes, including cartography, disaster relief, environmental compliance



Inspecting a teak forest plantation, near Chiang Mai, northern Thailand. Pictured from left to right: RFF fellows Roger A. Sedjo and R. David Simpson and Project Director Suthawan Sathirathai of Chulalongkorn University, Bangkok.



## GOINGS ON

monitoring, oil exploration, and urban planning. The few restrictions include the U.S. government's right to require companies to turn off commercial cameras during war or international tension and its right to deny access to some foreign customers.

By permitting commercial enterprises to engage in remote sensing the government has opened the way to an industry that some predict will net billions of dollars annually and follow the communications satellite industry as the next space-based commercial success. At the same time, the decision raises legal and political questions involving such issues as privacy and national sovereignty that may take years to resolve. To study these questions as well as the ongoing economic implications—and additional commercial possibilities—of remote sensing, the National Aeronautics and Space Administration has renewed its cooperative agreement with Macauley.

Measuring the returns government can expect to recoup from investments in research and development is challenging, she says—and certainly no less so in the case of technology transfers. In short, workable approaches to quantifying in economic terms the effects of technology transfer activities do not exist. But the demand for them does. The call for greater accountability in government—including “metrics” to demonstrate effective performance—applies as much

to NASA as it does to other federal agencies.

In addition to her research on remote sensing, Macauley is working with RFF researchers Mike Toman, David Austin, and David Simpson to assess ways that NASA's Jet Propulsion Laboratory can measure the benefits and costs of international participation in U.S. government-funded R&D. In a separate project for JPL, Macauley and Austin co-chaired a workshop this past winter on measuring the economic return to government-funded space activities. The two researchers also have a grant from the California Institute of Technology for broader research into the economics of space technologies. ☞

### EPA and the air: “future-talk”

No fortune-tellers made predictions at the symposium RFF held in February on EPA's proposals to tighten air quality standards for ozone and particulate matter. But that's not to say those who attended the day-long event wouldn't have liked to see into the future—at least as far as July 19. That's when the agency will make a final decision on the proposals it issued last November, based on its conclusion that current air standards for the two pollutants do not adequately protect public health—especially the health of the elderly and people with respiratory problems.

Whether the agency actually will go ahead and tighten

national standards for ground-level ozone and set first-time limits on fine particles in the air is still anybody's guess. But the prospect has members of Congress fighting over the larger question of how EPA should set standards and administer the Clean Air Act.

More to the point, but also open to question—and considerable difference of opinion—is how serious the health hazard is and just how much relief we could expect to get from more stringent standards. In sponsoring an opportunity to consider those questions—as well as related ones involving costs and benefits, implementation issues, and the role of Congress—RFF hosted an array of officials and experts from EPA, universities, industry, the states, Congress, and environmental advocacy organizations, who offered their assessments of the proposed standards as well as their opinions as to what EPA ought to do.



Panelists at RFF symposium discuss the costs and benefits of EPA's proposed new air quality standards.

Among those who discussed the level at which the standards should be set were Morton Lippmann from New York University's Norton Institute of Medicine; Mary Nichols, assistant administrator for air and radiation at EPA; and Roger McClellan of the Chemical Industry Institute of Toxicology. Weighing in on the costs and benefits of the proposed new standards were EPA's Robert Brenner, Chevron's Steven Ziman, the American Automobile Manufacturers Association's Richard Klimisch, and RFF's Alan Krupnick.

How to implement new standards was taken up by EPA's John Seitz and by Donald Theiler, who directs the State of Wisconsin's Bureau of Air Management. Robert Wyman of the law firm Latham & Watkins and David Hawkins of the Natural Resources Defense Council also addressed implementation issues.


Jimmie Powell, a staff member for the U.S. Senate Committee on Environment and Public Works, discussed the role of Congress in setting air quality standards, as did C. Boyden Gray of the law firm Wilmer, Cutler and Pickering and NRDC's Hawkins.

### RFF briefing paper

At the time of the symposium, RFF released a briefing paper on the subject of revising air quality standards written by J.W. Anderson, formerly a member of the *Washington Post's* editorial page staff and currently RFF's journalist in residence.

Anderson provides background on what led EPA to propose the revisions, including how the Clean Air Act enters into the picture. He provides a Q&A approach to discussing the proposed standards, their stringency, attainment, and associated costs and benefits.

He believes that EPA makes a much stronger case for reducing particulate matter (PM) than ozone. Reducing either pollutant would be expensive, he says. But in terms of health benefits, Americans would get a much higher return on their money spent to reduce PM than ozone. Anderson also questions whether some cities that are out of compliance can ever clean up their air enough to meet EPA's current ozone standard, let alone the tighter one proposed.

 Access a synopsis of the symposium and the briefing paper at <http://www.rff.org> or call RFF for copies.

## Advanced technology and climate change

As part of RFF's Climate Economics and Policy Program, RFF and Carnegie Mellon University co-hosted a workshop in March for economic theorists and empirical modelers to consider how technical change might reduce the cost of cutting emissions of greenhouse gases. As the United States considers the consequences of "binding targets" for such emissions reductions, interest appears to be growing in the contribution of new advanced technology to do the job. The hope is that technological advances can reduce carbon dioxide and other greenhouse gases at a much lower cost than policies that simply achieve reductions through a process of economic contraction.

The attractiveness of the approach does not make it easy, RFF's Director of the Quality of the Environment Division Raymond Kopp told those who attended the workshop. How to prompt development of such technologies is not clear, Kopp said—nor are the potential cost savings.

Thinking about the problem raises a number of questions about what governments should do. Should they, for example, subsidize research and development projects to stimulate low-emission technologies? What kinds of innovations might result from policies that induce greenhouse gas reductions by rais-

ing energy costs? Should they adopt early abatement strategies so that a process of "learning by doing" leads to cost reductions from accumulated knowledge? What costs to the economy as a whole might be incurred by redirecting innovation efforts from other areas to energy efficiency and renewable resources? And what kinds of empirical and policy research can help answer these questions?

The RFF-CMU workshop, which Kopp coordinated, included panel discussions on current modeling practice, government policies to induce technical change, and the need to link theoretical and empirical knowledge to models for the analysis of policy options. Panel participants included faculty from a range of universities across the country and staff from the U.S. DOE, the EPA, national laboratories, consulting firms, and several European institutions. ☞

## Productivity study reaches midpoint

Funded by the Alfred P. Sloan Foundation, RFF researchers are investigating the causes of productivity change in four natural resource industries that are major contributors to the U.S. economy (see "What Drives Productivity in Natural Resource Industries?" in *Resources*, Spring 1996, no. 123). In March the researchers reached the midway point in their two-year

project. They marked the occasion by convening a meeting of outside experts to help them evaluate their findings to date and advise them on future work. Eventually, RFF plans to publish a book on the findings of this research program, and will seek other forums for dissemination and discussion as well.

The study is being carried out to better understand the effects of technological innovation on the costs of production and to identify ways in which new technologies are diffused throughout a particular industry as well as the world. Although productivity growth has had obvious impacts on industrial performance, economists have not yet convincingly explained how productivity gains are generated.

The RFF researchers hope to use their findings to speculate about future production of petroleum, coal, forest products, and copper in the United States. They also seek to better understand the long-term competitiveness of U.S. firms in these resource industries. In analyzing productivity growth, the researchers are attempting to distinguish between changes in productivity that increase a resource base and those that make extraction from the existing base less expensive. Later on they may consider a broader cross-section of natural resource industries and compare domestic and foreign productivity performance within them. ☞



## GDP: Does It Matter?

As developing nations experience improvements in material well-being, sooner or later they must focus on preserving and building on their progress, despite social dislocation, environmental degradation, and overall global economic change. Rich countries worry, too, over this struggle for “sustainable development,” an elusive concept subject to much debate. Among the many things open to question is which indicators to use for evaluation. One such indicator is Gross Domestic Product (GDP), the market value of total output of goods and services in a country's economy.

Some analysts say we should drop GDP as an indicator entirely, claiming the measure is too deeply flawed to track the factors that make or break a country's capacity to take care of its people.

Those (primarily economists) who defend continued use of GDP, as one among numerous measures, counter: Do you throw out the baby with the bathwater? Do you abandon GDP for its well-known inability to fully reflect and track various indicators of human welfare?

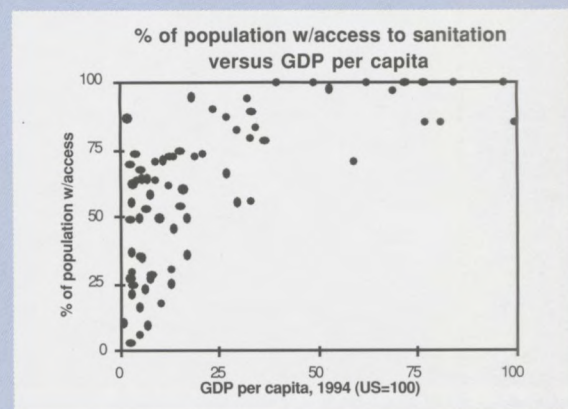
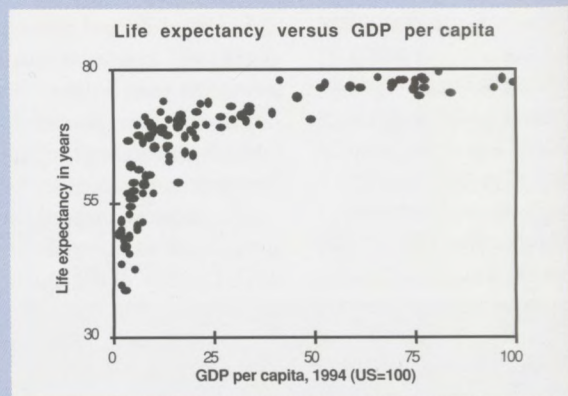
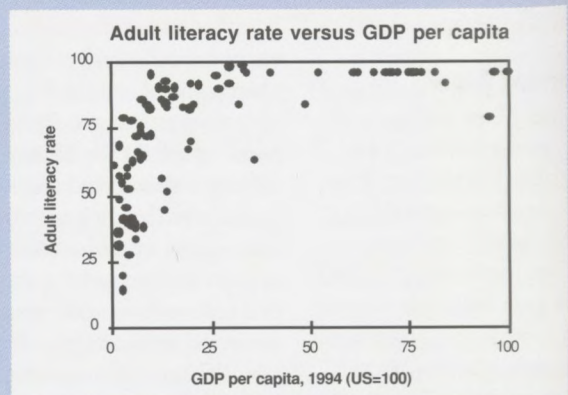
Well-known because economists have long noted, for example, GDP's inadequate treatment of natural resource depletion and its almost entire neglect of environmental degradation. Most economists nonetheless do not dismiss GDP's considerable value for policy analysis and strategies.

Our conclusion: GDP, though imperfect, has value. It is a measure which, over a sizable range of the international income ladder, is likely to correlate well with some key contributors to standards of living. Even where a society chooses to use the proceeds of its GDP “misguidedly,” the measure still captures the capacity and potential of that society to improve the lot of its people. While we should not rely exclusively on GDP as a measure of progress, neither should we jettison it quite as casually as some people seem prepared to do.

—Joel Darmstadter and Ron Lile

**The charts on this page:** In cross-sectional representations covering 114 countries in 1995, three important social and developmental indicators assembled by the World Bank are plotted against GDP (as adjusted for variations in purchasing power of different currencies). **Literacy** parallels GDP quite consistently, until a level of income equal to approximately US\$5700 (22 percent of the U.S. level) is reached. This correlation does not necessarily mean that a growing GDP is responsible for improved literacy or vice versa. But the relationship is there for the record—and further study.

Life expectancy and access to sanitation behave similarly, although in both cases the correlations plateau long before the income levels of the wealthiest nations are reached. Some significant measures of progress show little relationship to per capita GDP. For example, infant survival rate (not plotted here) doesn't seem to be associated with GDP at all—possibly because of inexpensive and simple practices like rehydration.



# Energy Trading

## The Market's Response to Deregulation

By Vito Stagliano and Sarah Emerson

Remarkable changes have resulted from the decision to deregulate oil markets sixteen years ago. What lessons can be applied to increased competition in the markets for electricity and natural gas? Will expectations be realized?

The energy sector of the U.S. economy has changed in extraordinary ways. Today the prices we pay to heat and light our homes and offices, cook our food, and drive our cars are, when adjusted for inflation, about what they were in 1949. Widespread concerns about the security of energy supplies have diminished, also. Sooner or later Americans will buy all of their energy on the open market—probably from nationally

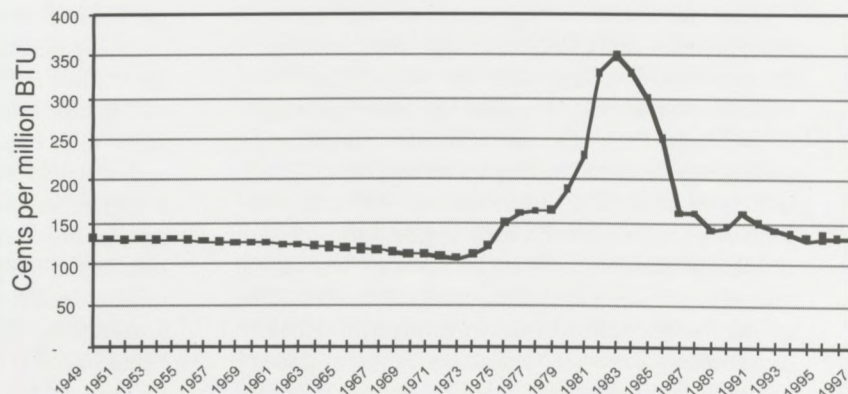
known energy companies rather than local utilities—and get better service into the bargain. These benefits derive from an epochal shift in responsibility for setting energy prices—from the purview of governments and

cartels acting in secrecy to free agents trading publicly in the marketplace.

Oil markets have been free of regulation for sixteen years. More recently, policymakers have been focusing on increasing competition in the natural gas sector and on liberating electric utilities from government's long-established control. The shift away from government regulation of energy has led to something per-

haps even more important than implacable downward pressure on the price of a barrel of oil. It has instigated development of multiple trading centers—in New York, Rotterdam, Singapore, and elsewhere—that are

**Composite Fossil Fuel Production Prices: 1949–1997**  
1987 Real Dollars



Energy prices today are about what they were in 1949, when adjusted for inflation. It is noteworthy that these prices reached historically aberrant levels only during a period of intense government regulation—1973–80.

## Deregulating Natural Gas

Much remains to be done before American consumers realize the full benefits of what will certainly become a highly competitive market for gas. Congress intervened heavy-handedly in the natural gas sector from 1973 to 1989. It sought to control most aspects of the production and use of this energy, which it considered limited in supply and too precious to use widely. For a decade, Congress actually banned its use in industry and for power generation. The consequence of this restrictive policy was that the price of a thousand cubic feet of gas rose from its typical wholesale price of about \$1.50 to over \$3.00 by 1980, despite clear evidence that the United States—and North America—had supplies of it that would last centuries, and would be cheap to produce. The evidence did finally convince a Democratic Congress and a Republican President to deregulate gas production prices in 1989. But even then the resulting Natural Gas Wellhead Decontrol Act did not fully let go of federal price fixing until 1992.

Meanwhile, most state regulators still do not allow residential and commercial gas consumers to choose their suppliers in an open market. Rather, such customers must continue to purchase gas from so-called local distribution companies (LDCs) that remain regulated monopolies. Does this make a difference in the price that these consumers pay for gas? The evidence suggests that it does.

But change is coming. Some states have accepted the idea of a fully competitive natural gas market and are beginning to allow some retail consumers to choose suppliers. These states are proceeding along this path at the very same time that they are coming to terms with consumer choice and market competition in the electric power industry.

dedicated to competition in free trade for crude oil and related products.

Free trade has unearthed more knowledge about the value of fuels—and of the technology that transforms them into useful energy—than was ever the case in a regulated market. The New York Mercantile Exchange (NYMEX) has been especially active in developing trading structures and trading instruments for oil, gas, and power. In the United States alone, which accounts for only a fraction of world trade in petroleum, the NYMEX oil futures market trades anywhere between 80 million and 150 million barrels of oil daily. This volume of trade, which is almost *ten times greater* than U.S. daily consumption of about 17 million barrels, exerts greater influence on the price that consumers pay for gasoline, fuel oil, and other products than does any other force at play in the international oil market, including the Organization of Petroleum Exporting Countries (OPEC).

## Energy and the Price of Toilet Paper

Does any of this trading activity really matter to ordinary people? Yes, but not obviously. Once goods and services enter the world of commodity markets, they become part of a trading system so vast, and now so global, as to make it difficult for any individual or group to manipulate supply and price as OPEC did during the notorious decade of energy crises. Identifying causes and effects of price changes also becomes difficult when markets take over. Consider something so common as toilet paper.

Paper mills, a great many of which burn residual fuel oil to power their plants, make products whose prices must necessarily reflect the energy cost of production. In the eastern half of the United States, the price that paper mills pay for fuel oil is set in the so-called New York Harbor (NYH) for fuel oil. The price of NYH oil is, in turn, shaped by the interplay between supply and demand on the U.S. East Coast, and by political and market developments in other regions of the world—as distant as Siberia.

Siberia? In recent years, one of the most influential factors shaping NYH prices has been Russian fuel oil export policy. During the last three winters, the Russian government has either banned fuel oil exports altogether, or has so heavily taxed the export barrels as to make them uneconomic on the world market. Russia has done so to guarantee availability of this same fuel to electric power plants in its own remote regions. Interestingly, barely a drop of Russian fuel oil ever actually makes it to the East Coast of the United States under any circumstances. But the imposition of Russian export controls dramatically elevates prices in NYH because it reduces the volume of fuel oil available to the highly integrated "Atlantic basin" market. Thus, because most paper mills buy fuel oil through long-term contracts tied to the spot price in New York, they are quite vulnerable to any price fluctuations anywhere in the system. Any increase in energy input costs ends up reflected in the price of toilet paper. (The spot price reflects a market where transactions take place immediately. Unlike futures markets, the commodity being traded is on hand and delivered to buyers "on the spot.")

The impact of Russian oil export policy can also be felt by electricity consumers in New England. In that region of the United States, plant capacity to generate



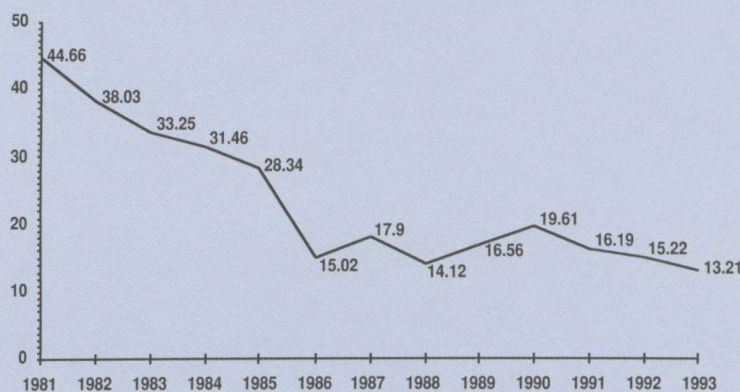
electricity by using oil happens to be significant. The fuel oil that New England utilities purchase is typically priced off the same NYH market used by paper mills. To the degree that the electric utilities have supply contracts tied to spot prices, they are as vulnerable to changes in Russian export policy as are the paper mills.

As deregulation of electric utilities moves forward, events in places as remote as the frozen tundra of northern Russia will affect energy buyers in New England. And so if an increase in the price of toilet paper does not grab the attention of U.S. consumers, the rise and fall of electricity prices surely will.

The news about deregulation is of course not invariably positive. Along with vigorous competition, free markets also bring uncertainty and unpredictability—a kind of trading frenzy that results in price volatility. From time to time, and for reasons that are not entirely obvious to the average consumer, prices of commodities such as oil go up, sometimes sharply, recurrently and repeatedly, and always inconveniently. This was the case, for example, in the winter of 1996–97, when American consumers experienced unexpectedly high prices for the oil they use to heat homes and buildings. During the same winter, consumers were also subjected, albeit briefly, to extremely high prices for natural gas. Politicians reacted to these events by calling for government to intervene by, for example, releasing stocks held in the Strategic Petroleum Reserve.

That politicians feel pressure to step in and “fix” sudden price spikes is not surprising. Reliance on the market is hardly a policy carved in stone. And even when the commitment to competition is made, economic deregulation in a sense never really ends. Crude oil and markets for related products, for example, continue to require tinkering. The U.S. gasoline market was so fragmented by implementation of regulations related to the Clean Air Act amendments of 1990 that trading in gasoline futures remains unviable—an unintentional but nonetheless significant consequence. Similarly, the natural gas market, some aspects of which are still heavily regulated at both federal and state levels, has proven difficult to organize in a manner that protects the interests of all consumers (see “Deregulating Natural Gas”). The electric power market, meanwhile, is just getting organized. In terms of value and volume of trade, it

## Crude Oil Refiner Acquisition Costs, 1981–1993 (Nominal Dollars/Barrel)(Domestic/Imported Composite Cost)



Source: Energy Information Administration, U.S. Dept. of Energy: Annual Energy Review, 1994

Deregulation of the energy marketplace can be said to have begun as a result of an Executive Order that President Reagan issued two weeks after taking office in January 1981. The order had an immediate effect on crude oil prices—an effect so powerful that it drove OPEC into a strategic tailspin. Deregulation of the U.S. oil sector fostered a profound reevaluation of the market value of a commodity, which barely two years earlier had been thought to be worth \$50 to \$100 per barrel.

will be larger than all other energy markets combined (see “Trading in Electrons”).

### The Hedging Solution

For every problem created by deregulation, however, markets are proving capable of devising solutions. Some paper mills and electric companies, for example, have turned to investment banks and trading houses to find protection from the price volatility of markets like those for fuel oil. So-called hedging instruments for managing price risks, developed first in the oil markets, then in the natural gas markets, and now in the electric power markets, provide financial vehicles for large consumers to “lock in” energy prices over a specified period of time. These instruments free them from the price volatility that characterizes trade in spot markets. Moreover, they can use other financial tools, like price options, to capture a windfall if a price falls well below the guaranteed price they locked in previously. So, in the imminent market for competitive electricity—and for other energy traded as commodities—the happiest consumer will be the one that chooses a clever hedger for a supplier.

The average home owner is, of course, unlikely to

## Trading in Electrons

Less than four years after Congress enacted the Energy Policy Act of 1992 (EPAct), the New York Mercantile Exchange (NYMEX) made history by opening trade in electrons at two West Coast market hubs: California-Oregon Border and Palo Verde, a switchyard in Arizona. Since May 1996, NYMEX traders have taken on the difficult task of determining what electricity is truly worth in the marketplace. For the previous sixty-two years, regulators had established the value of electrons, and assigned rates that local utilities would have to charge their captive customers. But the cumulative consequences of regulating electricity proved to be uneconomic; a competitive market could deliver power at lower cost. This was—and is—the impetus for restructuring America's largest energy industry.

The market for trade in electric power is likely to be difficult to organize and manage. Unlike oil and gas, electrons cannot be produced and stored for later use, and the path they are made to travel from power station to home and business is subject to unforgiving laws of physics. Even with these complexities, markets for electric power are nonetheless emerging and being organized. "Spot markets" exist in every region of the country, where power is on hand and delivered to buyers immediately. The futures market, where the electrons usually are not physically present but are bought and sold via contracts that specify a delivery date and fix a price, will continue to evolve as new contracts are tested in new market centers. Within five years, free trade in the \$200 billion electricity market will likely be routine.

have the means or the opportunity to check on the financial management skills of the energy companies that offer service. Here the responsibility falls back on the regulators. They who previously devoted their greatest efforts to setting rates will, in the deregulated world, devote time and vigilance to ensuring that markets are competitive. A monopolist has no motivation to reduce price risk exposure because it can pass that risk (and the higher cost) on to the consumer. In a

competitive market, however, where consumers can shop around for the energy they need, the vendor with the lowest price is likely to prevail. Other factors being equal, the vendor that sells at the lowest price is also the most likely to have protected itself against volatility.

### Freedom Is Worth the Risk

The value of energy has preoccupied governments on all continents since economies first became dependent on commercial fuels. Energy has been priced too high or too low relative to its market value because governments have insisted on saddling its trade with myriad social and security burdens. Despite the fact that deregulation remains an unfinished business, what has occurred thus far presents fairly clear evidence that free energy markets result in lower costs to consumers. If it remains for the political establishment to take this evidence and make it enduring policy, at least a precedent exists for doing so. The impetus toward greater energy sector deregulation can be traced to the hotly debated Energy Policy Act of 1992 (EPAct). It took Congress nearly two years to forge a consensus in support of this legislation. But perhaps more than any other energy legislation in recent memory, this law sent a strong signal that the federal government was finally fully committed to free trade in energy.

Markets are risky, and their organization and management are sometimes flawed. But as Winston Churchill used to say of democracy, they are better than all the other alternatives.

The authors are directors of Energy Security Analysis Inc. (ESAI), a firm that specializes in analysis of physical and paper energy markets. Vito Stagliano was a visiting scholar at RFF in 1995–96 and was one of the authors of *A Shock to the System*, RFF's primer on electricity restructuring.



# A Framework for Climate Change Policy

by Michael A. Toman

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Differing interpretations of the evidence—and differing interests—complicate efforts to negotiate goals and actions regarding climate change. While no easy cookbook-style recipe can indicate what should guide thinking about risks and policies, several maxims seem worth applying.

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**A** great deal of controversy surrounds the issue of climate change. Some say that climate change is one of the greatest threats facing humankind, one that calls for immediate and strong controls on greenhouse gases from fossil fuel burning. Others say that the risks are weakly documented scientifically, that adaptation to a changing climate will substantially reduce human vulnerability, and that little action is warranted other than study and development of future technological options. The same kinds of divides arise in discussing policy options to reduce greenhouse gas emissions, with some predicting net benefits to the economy and others fearing the loss of several percentage points of national income.

These disagreements surface in the efforts of the international community to negotiate goals and actions under the 1992 Framework Convention on Climate Change. They reflect different interpretations of the evidence and different interests. To help sort through the tangle, I have summarized some ways to think about climate change risks and policies that may be useful in considering both international agreements and actions by the United States.

## Decision Framework

While no easy recipe indicates what should go into a climate change decision framework, several maxims seem worth applying.

*Think comprehensively about risks and costs.* Efforts to gauge the benefits of reducing climate change risks should be as broad as possible. Elements to consider include the impacts on market goods like agriculture; effects on human health; effects on nonmarket resources like wilderness areas and wetlands that provide both recreational values and ecological functions; and the ancillary benefits of greenhouse gas reduction such as improved air quality. It is just as important to think broadly about control and adaptation costs, including indirect effects on the economy as well as direct compliance expenditures.

Given the current state of knowledge, it will be difficult to attach monetary values to a number of risk reductions and costs. This uncertainty is likely to persist for many risk categories (especially those related to ecological impacts) even if uncertainty about the physical manifestations of climate change declines. However, lack of information should not be confused with negligible risk. To be useful to decisionmakers, moreover, an assessment of climate change risks should go beyond a sequence of “best guess” or “worst case” estimates of atmospheric changes, biophysical impacts, and socioeconomic impacts to consider the variability of possible consequences.

*Think long-term.* The risks posed by climate change depend on the path of changes in the atmospheric concentration of greenhouse gases over many decades

## RFF Climate Change Research

RFF launched its Climate Economics and Policy Program last fall to conduct basic and applied research and policy analysis related to global climate change. An initial set of research projects under way includes:

- Bringing Uncertainty into the Equation When Calculating Climate Change Risks
- Carbon Consequences of Tax System Reform
- Carbon Policy and Endogenous Technical Change
- Discounting in Intergenerational Decisionmaking
- Economic Analysis of Greenhouse Gas Emissions Trading
- Effective Environmental Policy in the Presence of a Distorted Tax System
- Electricity Restructuring and the Costs of Controlling CO<sub>2</sub>
- Impacts of Climate Change Mitigation on Other Environmental Problems
- International Cooperation for Effective and Economic Greenhouse Gas Limitation
- Vulnerability of Low-Income Households to the Hydrologic Effects of Climate Change

To broaden understanding of climate change concerns, RFF is also organizing workshops and producing a series of Issue Briefs. The first of these, "Climate Change Risks and Policies: An Overview," is the source of Michael Toman's article.

### For more information:

<http://www.rff.org/research/programs/climprog.htm>

and centuries, not just on the emissions of these gases over a relatively short period of time. We are dealing with the cumulative effect of many smaller influences on the biosphere—an effect with a great deal of natural inertia.

Having to confront the distant future greatly complicates risk assessment and the development of consensus for policy actions. To be effective, at least some actions must anticipate long-term impacts, before all of the scientific evidence is clear. Our political system

arguably is less effective at taking such actions than responding to a single large and immediate concern. On the other hand, the long-term nature of climate change risks means we can hone our scientific understanding and policy responses over time; we need not do everything right away.

**Address adaptation.** In areas such as agriculture, managed forestry, and human settlements, intuition and experience in other contexts suggest a medium-to-high degree of potential adaptability to natural changes, given enough lead time and investment. Adaptation possibilities include development of new plant varieties and crop patterns, changes in irrigation technology, relocation of coastal infrastructure, and expanded protection of wetlands to compensate for their potential future damage.

Adaptation may be difficult in some cases, for example, where damage occurs to natural ecosystems whose functions are not well understood. But even when adaptation capacity seems very limited, it should not automatically be treated as negligible. Improving the capacity to adapt where it is weak—as in many poor, developing countries—may be one of the most effective ways to respond to some climate change risks, at least until the cost of stabilizing atmospheric concentrations of greenhouse gases falls.

**Think internationally.** Rich and poor countries argue over how the burden of greenhouse gas emissions reductions should be allocated. The ongoing tension can only be resolved by negotiation among the parties themselves. However, long-term global climate change risks will not diminish to any significant degree until total global emissions are reduced, and this will require global cooperation, not just action by today's rich countries. This point deserves to be underscored in light of the likely future decline in the share of total emissions from advanced industrial countries (currently about 50 percent) as economic growth proceeds in other areas. The efficacy of any policies the United States pursues to reduce climate change risks thus will depend on the actions taken by others.

**Keep distributional issues in mind.** Climate change risks and response capacities vary with income level. There is also a fundamental asymmetry between the timing of response costs—which will largely be borne by the current generation—and the benefits of reduced climate change—which will largely accrue to future generations. This asymmetry means we cannot simply

compare the costs of reducing the risk with the value of enjoying the ultimate benefits. Instead, we must assess both the costs members of the current generation would bear and the strength of our concerns for those who would be vulnerable in the future. These are economically and ethically complex questions about which we know little, and they require mature political debate.

**Estimate control costs realistically.** Some people argue that market inefficiencies are so rife, and opportunities for innovation so plentiful, that emissions abatement is a low-cost proposition or one that might even benefit the economy. This point of view is in sharp contrast to the outputs of economic models indicating that stabilizing emissions may cost as much as several percent of a country's gross domestic product (implying that deeper cuts in emissions to reduce greenhouse gas concentrations in the atmosphere would be even more expensive).

Most people who have looked at the debate seem to agree that some low-cost improvements in energy efficiency exist, for example, by reducing subsidies and other market distortions. However, it is open to question whether these opportunities are substantial compared with, say, the amount of abatement needed to stabilize greenhouse gas emissions. Against the backdrop of future increases in global energy demand, the cost of longer-term reductions in greenhouse gas emissions cannot help but rise unless further progress occurs in the development of nonfossil energy alternatives. In assessing medium- to long-term costs, it is a mistake to assume technical progress as a panacea for reducing abatement costs, or no technical progress at all.

Another argument is that our tax system is so distorted that we can levy energy taxes to reduce greenhouse gas emissions and use the proceeds to lower other taxes that hamper economic growth. However, recent analysis calls into question this "double dividend." The basic conclusion of this analysis is that broader-based taxes like those on income generally create less overall economic distortion than narrower-based taxes like those on energy. Thus, adjusting other taxes might dull the economic pain of an added energy tax, but not to negligible levels. Moreover, any tinkering with the tax system is possible only if politicians take the difficult step of imposing higher energy taxes in the first place.

## RFF Council Takes Up Climate Topic

The RFF Council took up the topic of "Climate Change: Policy Issues and Options" at its seventh annual meeting in April. Council members heard from scientists as well as experts in government, academia, and the business and environmental communities on this critical and controversial issue.

In a plenary session on how to think about climate change policy, RFF Senior Fellow Michael Toman was joined by American Petroleum Institute Executive Vice President William O'Keefe and Daniel Lashof, a senior scientist at the Natural Resources Defense Council. Toman and RFF Senior Fellow Raymond Kopp later led respective discussions on technical responses to climate change and implementation of policies.

Rafe Pomerance, the U.S. Department of State's deputy assistant secretary for environment and development, spoke of the challenges of negotiating international climate agreements. Everett Ehrlich, the U.S. Department of Commerce's under secretary of commerce for economic affairs, discussed the implications of climate change policies as they might affect the United States in particular.

Most studies of greenhouse gas abatement costs assume the application of idealized least-cost policy measures like a comprehensive "emissions trading" program or a comprehensive "carbon tax" based on the carbon content of different fossil fuels. Abatement costs will be higher (perhaps considerably so) if less than ideal policies are used in practice. The debate about which greenhouse gas reduction targets are appropriate cannot be conducted independent of discussions about what concrete measures can and should be used to actually restrict emissions.

### Implications for Policymaking

The decision framework I have described has several implications for formulating policy.

**Allow flexibility in the timing of cumulative emissions reductions to reduce overall costs.** The potential cost savings from intertemporal flexibility in meeting a particular long-term emissions-reduction goal depend on the assumptions made, but it appears that savings of at least 20 percent or more are possible. Taking this approach

does not mean that all or even most policy actions are deferred to the future. It simply means that the emphasis is placed on sequential decisions—some of which are better taken sooner and others later. Unless we start with a longer-term perspective, it is impossible to consider such tradeoffs.

***Incorporate economic incentives into emissions-reduction policy.***

These incentives include carbon taxes on energy sources and various forms of tradable permit systems that would effectively establish quotas on emissions but allow their trade. Sources with higher control costs could (in effect) pay emitters with lower control costs to assume more of the reduction burden.

***Provide opportunities for emissions reductions wherever possible.***

One example of an abatement incentive program that takes place outside industrialized countries is the so-called “joint implementation” approach, whereby emitters in, say, the United States, can satisfy any emissions reductions requirements they face through actions that reduce emissions in other countries. Formal emissions trading programs among sources in countries with quantified emissions reduction targets also are possible. Significant practical questions need to be answered to structure flexible yet verifiable programs for international (and intertemporal) emissions trading. However, the magnitude of the potential cost savings underscores the value of seeking to overcome these challenges. Depending on the assumptions made, savings of 50 percent or more seem possible.


***Build knowledge and improve technology.*** Even if we do all the best things possible to reduce emissions, given the current state of knowledge, economic growth—especially in developing countries—will continue to push up greenhouse gas emissions and atmospheric concentrations. Unlike limiting pollutant gases such as sulfur dioxide, for which a variety of technical control options is available, limiting carbon-dioxide emissions requires reduced energy use, greater energy efficiency, or substitution of energy sources with lower carbon content.

To avoid unacceptable climate change risks ultimately will require a fundamental change in our energy systems toward much greater reliance on other energy sources—solar, biomass, and possibly nuclear. To make the transition economically manageable will require continued or enhanced investments in basic and applied knowledge.

The government has an inescapable role to play not just in creating the incentives for private parties to seek better technologies but also in funding the development of basic knowledge about technology as well as climate change impacts. At the same time, we must recognize that our understanding of what policy can actually do to induce climate-friendly innovation is weak at best. We must also recognize that diverting resources from other areas to research on low-carbon energy systems may well reduce innovation elsewhere in the economy—technical progress is not a free good.

***Increase emphasis on adaptation.*** Adaptation is part of an optimal response strategy in any event. Indeed, it is the means of transcending the narrower concern about our vulnerability to climate change to a broader concern with global-scale changes that place stress on natural systems and pose threats to human well-being. Furthering human capacity to adapt to climate change entails investment in improved understanding of the options and their international application. It also entails adjusting economic and other distortions that limit adaptation potential (such as assistance programs that subsidize coastal development or water use). In many cases, the best climate policy may have little to do with greenhouse gases or climate per se, and much more to do with developing better basic social infrastructures for natural resource conservation and use and for public health protection.

Michael A. Toman directs RFF's Energy and Natural Resources Division and coordinates its Climate Economics and Policy Program.



# Preparing America's Food Safety System for the Twenty-First Century

by Michael R. Taylor

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Recent regulatory changes will help the food safety system focus on prevention and should clearly define the respective roles of government and industry. But more work is needed to assure the system's future success.

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In announcing a new round of food safety initiatives in connection with his FY98 budget proposal, President Clinton called for a national discussion about the future of the nation's food safety system. Recently, federal agencies have gone a long way toward improving that system by adopting a regulatory framework that focuses attention on prevention and more clearly defines the roles the food industry and the government must play. But as the President's new initiatives indicate, more work needs to be done—and new working relationships forged—in preparing our food safety system for the next century.

The organizational and statutory fragmentation of the current system makes it difficult for the federal food safety agencies to take full advantage of the newly adopted regulatory framework. Efforts to assign clear responsibility and accountability for food safety within the government are frustrated by the fact that several different federal agencies are involved in regulatory matters concerning food safety. They operate under thirty-five distinct statutes. Further, although the federal government spends more than \$200 million annually on food safety research, no formal mechanism or strategy exists to coordinate the twenty-one distinct federal agencies conducting such research

(see "A Fragmented Food Safety System"). To say the least, the current "system" is not the one anyone would design if starting from scratch.

The new federal framework for food safety regulation is cause for optimism nonetheless. To understand why requires some familiarity with the current U.S. food safety system, which actually consists of two systems: one for meat and poultry, administered by the U.S. Department of Agriculture (USDA), and one for seafood and all other foods, administered primarily by the Food and Drug Administration (FDA). It is these two agencies that have decided to adopt a new regulatory framework based on what is known as a Hazard Analysis and Critical Control Points (HACCP) approach.

## America's Two Food Safety Systems

In the USDA system, inspectors carry out "continuous inspections" of meat and poultry plants by physically examining every carcass passing through slaughterhouses and making daily inspections of plants that process products ranging from fresh, cut-up chicken parts to pepperoni pizza and chicken noodle soup. USDA employs nearly 7,500 full-time inspectors who continuously inspect more than 6,000 plants. In

## A Fragmented Food Safety System

Responsibility for America's food safety is widely dispersed among government agencies at federal, state, and local levels. The roles of these agencies vary widely depending on their statutory authority and resources. The resulting fragmentation undercuts the government's ability to marshal the most effective food safety program possible and it muddles accountability. A few examples illustrate this point:

- FDA is responsible for the safety of eggs in shells and USDA for the safety of processed egg products, but it is USDA—not FDA—inspectors that visit shell egg packing houses on a daily basis to grade eggs for quality.
- Plants producing pepperoni pizza are subject to daily inspections whereas those producing cheese pizza are rarely inspected. Meat accounts for the difference in oversight. USDA oversees the former type of plant and FDA the latter. USDA also inspects the animal from which the pepperoni was made at the time of slaughter as well as the processing of the meat into pepperoni.
- To implement the pesticide reform law that Congress passed last year, the Environmental Protection Agency will make hundreds of important food safety decisions about chemicals in foods—many more than FDA will make—even though FDA is considered the federal government's leading food safety agency.
- The Centers for Disease Control and Prevention (CDC) are responsible for monitoring foodborne illnesses at the federal level and they conduct investigations of outbreaks of illnesses at the invitation of state health officials. FDA and USDA also investigate outbreaks of illness, albeit for different purposes. While the CDC focus is on determining the causes of illnesses, the agencies look to see if regulatory action is needed, such as seizure or product recall.
- State and local agencies have their own food safety programs that play a critical role in the nation's food safety system. In addition to investigating outbreaks of illness within their boundaries, they conduct food safety inspections at the retail level—grocery stores and restaurants—and they have primary oversight for certain product categories such as milk products and shellfish.

Because fundamental structural reform in the federal government is politically difficult to achieve, the agencies are working among themselves to improve the existing structure, using HACCP as their conceptual framework.

1994, inspectors individually examined approximately 130 million head of livestock, and 7.5 billion chickens, turkeys, and other poultry. Carcasses and processed products cannot be shipped into commerce without the USDA mark of inspection.

The USDA system reflects its historical origins in the early 1900s, when the public's primary concerns were extremely unsanitary conditions in meatpacking houses and the use of diseased animals or visibly contaminated carcasses for human food. The system has worked well to address these problems, but it has done so by playing a prominent role in the operation of the plants it inspects and for the quality and safety of products leaving those plants. For example, USDA inspectors bear the primary responsibility for sorting diseased carcasses from wholesome ones; USDA approves facility blueprints, processing equipment, and product labels prior to their use; and inspectors, rather than plant managers, have traditionally made the daily decisions on whether or not a slaughter plant has been adequately cleaned and is ready to begin operations.

The strength of the traditional USDA system is that it puts government inspectors in a position to promptly detect and correct obvious food safety and sanitation problems. It also provides the assurance that many consumers evidently want—external oversight of production. The system's primary weakness is that slaughterhouses have no clearly defined responsibilities for preventing or minimizing contamination of carcasses with the most significant forms of contamination—microbial pathogens, such as *Salmonella*, *Campylobacter*, or *E. coli* 0157:H7—which are not visually observable by inspectors.

Moreover, before 1994, the USDA did not consider any microbial pathogens on raw meat and poultry products to be adulterants under law, partly because proper cooking was thought to kill the bacteria. This policy insulated slaughterhouses from responsibility for reducing bacterial contamination and meant that, when the presence of *E. coli* in hamburgers in the Pacific Northwest caused an outbreak of illness in 1993, USDA investigators determined that the inspection system had worked as it was designed to work. Unfortunately, the system's failure to assign responsibility for reducing microbial contamination undermines not only its effectiveness in minimizing the risk of illness but also the public's confidence in the safety of the food supply.



More broadly, the USDA system has also, in some respects, stood in the way of progress on food safety. For some companies, the extensive system of command-and-control regulation associated with continuous USDA inspection has discouraged or delayed adoption of new food safety technologies. For others, the USDA mark of inspection has been a crutch that plant operators have depended on in lieu of taking responsibility themselves for food safety and sanitation.

In contrast, the FDA relies much less heavily on inspection than the USDA does. The FDA instead ensures food safety by establishing quantitative limits on various chemical contaminants, specifying in some cases which microbial pathogens adulterate various foods, issuing regulations on the use of additives, and providing general guidance concerning the "good manufacturing practices" that FDA considers necessary to prevent insanitary conditions. FDA enforces these provisions when violations are encountered as a result of outbreaks of illness, consumer or industry complaints, or observations made during periodic FDA inspections.

FDA has jurisdiction over 53,000 establishments that produce, process, or store food, ranging from seafood plants to warehouses to high-tech food processing facilities. The agency's 250 food inspectors conduct about 5,000 annual inspections. A typical FDA enforcement action involves removal of an adulterated food from commerce, either through voluntary recall by the responsible company or through an FDA-initiated court action. Because FDA inspection is infrequent for any one firm—a year or more can pass between inspections, even in plants with relatively high-risk operations—the system relies heavily on the commitment and competence of food companies to produce safe products. Most companies take their food safety responsibility seriously.

The strength of the FDA system is that it has spelled out what it considers to be an appropriate standard of safety and, through its enforcement activity, has created added incentive for companies to meet those standards. The system's primary weaknesses are the infrequency of its inspections and its largely reactive stance: the system has lacked strategies and mechanisms to systematically anticipate and prevent the most significant food safety problems, such as ones associated with microbial pathogens.

### A New Approach: HACCP

In the 1960s, food industry experts developed the Hazard Analysis and Critical Control Points system to monitor foodstuffs at several important junctures in the preparation process, rather than waiting until products were ready to go to market before inspecting them for safety. The approach is a proactive and preventive one. The operator of a food production process develops a HACCP plan for producing safe food, one that identifies the potential hazards in the process—such as the possibility of harmful contamination with bacteria or chemicals. Such a plan also specifies process controls—for example, proper cooling of perishable raw materials or adequate cooking temperatures—that are validated as effective in preventing or minimizing health risks. Recordkeeping and monitoring procedures enable an operator to verify on a continuing basis that the controls are working and to detect and promptly correct food processing errors.

USDA adopted the HACCP system in 1996 following the recommendation of the National Academy of Sciences. In the early 1990s, FDA began developing its own HACCP-based food safety strategy for seafood, culminating in its 1995 regulations that mandate HACCP for seafood processors.

While food safety laws in the past have *implicitly* made food companies responsible for preventing safety hazards and producing safe food, HACCP makes their responsibility *explicit* and establishes a general standard of process control that companies must achieve. Under HACCP as adopted by USDA, for example, a slaughter plant's responsibility to target and reduce contamination with harmful bacteria is now crystal clear.

HACCP also clarifies the government's role. For example, USDA inspectors will continue to inspect each carcass in every slaughter plant and make daily inspections in processing plants, but they will no longer attempt to control—and, in effect, take responsibility for—so many details in a given plant's day-to-day operations. Instead USDA will focus on verifying through its inspection activity that every company-designed HACCP plan is appropriate and working properly and that each company is meeting food safety performance standards. For USDA, taking an HACCP approach will permit more efficient deploy-

ment of its inspectors, allowing them to focus on the most important food safety concerns in the plants they monitor.

For FDA, the HACCP system can compensate to some extent for the infrequency of its inspections. All HACCP plans include recordkeeping procedures to provide an ongoing indication of plant conditions and whether food safety controls remain effective between inspections. Documentation includes how plant employees have detected and corrected processing problems.

### Strategies for the Next Century

The HACCP approach is at the heart of the Clinton administration's farm-to-table food safety strategy. HACCP's core concepts—prevention, clearer assignment of responsibilities, and better use of resources—establish a solid foundation for the food safety system of the future, but it is only a first step. To satisfy the public's food safety expectations and realize the food industry's full potential in the global food economy will require a new kind of effort and collaboration. It won't simply be a matter of more regulation. What is needed besides are investments—and new mechanisms for management and coordination—to bolster the scientific capabilities of our food safety system and its readiness to address a changing set of food safety challenges, including those posed by foodborne illnesses and the globalization of the food economy.

Looking into the next century, reducing the risk of foodborne illness will remain a central priority and challenge. Food safety problems are persistent and new problems emerge, such as the recent appearance of *E. coli* O157:H7 in apple juice. Most experts agree that more efforts are needed to improve epidemiological surveillance, better focus and prioritize food safety research, and expand education of food service employees and consumers in safe food handling practices.

Fostering new technology is another challenge but also an opportunity. New technologies have long been central to building the safety, economy, and convenience of the American food supply, and the new

HACCP framework encourages industry adoption of new technologies and procedures to control harmful bacteria. Continued success requires investment in technology development, rigorous but prompt government approval processes, and public understanding and acceptance of technology and its benefits.

Trade-related issues will also loom large in the years ahead. Food imports and exports are expanding, and the growth prospects of American agriculture and the food industry rest heavily on meeting the rising demand overseas for high-quality, value-added food products. Traditional economic barriers are coming down, but food safety concerns are increasingly the basis for disruptions in trade. The United Kingdom, for example, is struggling to resume exports of beef in the wake of the "mad cow" disease scare, and the United States is contesting Europe's refusal to allow imports of U.S. beef from cattle treated with FDA-approved growth hormones. As the world moves toward greater harmonization of food regulatory standards, the U.S. challenge is to ensure that imported food continues to meet America's high safety standards and that U.S. exports are not blocked by unfounded concerns.

### An Opportunity for Collaboration

With all of these concerns in mind, the food industry, the government, and consumers should take President Clinton's food safety initiative as a cue and join in a collaborative process to resolve what we want our food safety system to do for us in the next century, who will be responsible for what, and how we are going to pay for it.

Michael R. Taylor is a visiting scholar at RFF's Center for Risk Management and is a partner in the law firm King & Spalding. Previously he was deputy commissioner for policy at FDA and the administrator of USDA's Food Safety and Inspection Service, where he played leadership roles in developing the HACCP reforms described in the article.



# Putting a Price on Solid Waste Reduction

Not all methods designed to reduce solid waste are paragons of economic virtue. In fact the differences in costs across programs can be quite substantial. So when a government selects an inefficient approach to discouraging garbage, it can be an expensive proposition. RFF Fellows Karen L. Palmer and Margaret A. Walls, along with Gilbert F. White Postdoctoral Fellow Hilary Sigman, suggest as much in their latest look at the costs of reducing municipal solid waste.

Like other economists who have studied this issue, Palmer, Walls, and Sigman operated on the assumption that most municipalities want to confront households with the full costs of handling and disposing of what they throw away. Illegal dumping, however, is the feared consequence of upfront approaches, such as charging households by the pound or restricting the quantity of garbage picked up.

With that in mind, the researchers looked at three indirect ways to make consumers sensitive to the costs of transporting and disposing of waste at landfills and incinerators: deposit/refund programs, which place a fee or deposit on a product when it is purchased and then refund it when the used product is returned for recycling; recycling subsidies, which offer monetary support to manufacturing firms that use recyclable materials; and advance disposal fees, which are charged to manufacturers to cover the ultimate disposal or recycling costs of their products.

To find out how much it costs to use each method, the researchers calculated what a municipality would have to charge in each instance to get a modest, 10-percent reduction in waste. To make their calculations, Palmer, Walls, and Sigman built a model of waste generation and recycling using price and quantity data

from 1990 for each of five materials—aluminum, glass, paper, plastic, and steel—that make up 56 percent of a typical American municipality's solid waste.

The RFF researchers found that the differences in cost across methods were significant. To get the 10 percent waste reduction through a deposit/refund program cost \$45 per ton; to get the same reduction through advance disposal fees and recycling subsidies cost \$85 and \$98 per ton, respectively. The deposit/refund cost was significantly lower because the method offers incentives to recycle and reduce consumption, whereas the other two methods encourage only one or the other.

Palmer and her colleagues thus confirmed what earlier studies have indicated: deposit/refund schemes are the least expensive way to make consumers bear the costs of waste transport and disposal, assuming that illegal disposal is an option. Having said that, the researchers note that advance disposal fees could be preferred if the administrative costs involved in running a deposit/refund program are high.

How policy is set makes a difference in waste reduction costs, also. Setting a single disposal price for all waste items is more efficient than setting reduction goals for individual materials, since some of them are cheaper to reduce (paper and glass) than others (metal). Using a deposit/refund system, for example, a 10 percent reduction in each of the five materials studied would cost almost twice as much as a 10 percent reduction across the board, the researchers found.



See page 22 to order the researchers' related discussion paper, "The Cost of Reducing Municipal Solid Waste" (96-35).

## A Modest Proposal

Right now RFF Fellow Karen Palmer and her colleagues think the true social cost of disposing of solid waste (including cans) is much lower than what consumers pay in states with so-called "bottle bill" deposit/refund programs. These programs are expensive to implement and administer.



If "Joe" is in the habit of tossing his empty six-packs into the garbage rather than recycling them in a state with a deposit/refund program, he'll end up paying much more for the privilege than it actually costs to cart the cans off to the dump or incinerator. (Costs include environmental damage like groundwater contamination and disamenities like the congestion and noise that garbage trucks create.)

The incentive for Joe to stop tossing out beer cans and start recycling them is more severe than it should be, the RFF researchers maintain. They say the deposit fee charged on the cans should be in line with what it costs to dispose of them.

That state bottle bills may be excessive is not to say consumers are off the hook, however. The RFF researchers confirm that we stand to gain economically if we can cut down on waste by a modest amount.



## INSIDE RFF

### Toman is new ENR director

Michael A. Toman is the new director of RFF's Energy and Natural Resources Division, where he has been a researcher since 1981. Toman replaces Douglas R. Bohi, who led the division for eight years before leaving RFF in mid-February to join the Washington office of Charles River Associates.

In addition to directing ENR, Toman will continue to coordinate RFF's Climate Economics and Policy Program. He helped launch the program after serving as a senior staff economist on the President's Council of Economic Advisers from September 1994 to February 1996.

RFF President Paul R. Portney had this to say about the change in tenure: "Mike will do an excellent job working with his colleagues in ENR—and throughout RFF—to identify an intellectually exciting research agenda, the results of which will help clarify policy decisions that the United States and the rest of the world face." At the same time, Portney expressed regret at Bohi's departure, praising him as "one of RFF's best researchers and policy analysts since he walked in the door."

Toman joined RFF after earning his Ph.D. in economics from the University of Rochester. He became a senior fellow in 1989 and has authored four books and over forty scholarly articles on a variety of topics.



Ruth Greenspan Bell

### Visiting scholar leads new program

Ruth Greenspan Bell, a lawyer who has carved a niche in legal institution building, has joined RFF's Center for Risk Management as a visiting scholar. Working with CRM Director Terry Davies, Bell is here to put in place a new program for international institutional development and environmental assistance (IIDEA). IIDEA will combine RFF's analytical research capabilities with Bell's legal advisory experience to help governments—as well as nongovernmental organizations, development banks, and other institutions—become more effective in implementing natural resource management and environmental protection laws.

Today most countries have environmental laws, and some 900 international agreements exist to solve difficult interrelated environmental issues around the world, Bell says. But getting results is another matter. Many of these laws and agreements

have not yet achieved their goals of controlling pollution and conserving natural resources. In fact, according to Bell, considerable work needs to be done to ensure that these agreements amount to more than symbols.

"The gap between commitment and actual pollution reduction must be closed if environmental risk is to be reduced," Bell says. To help countries close that gap is IIDEA's reason for being.

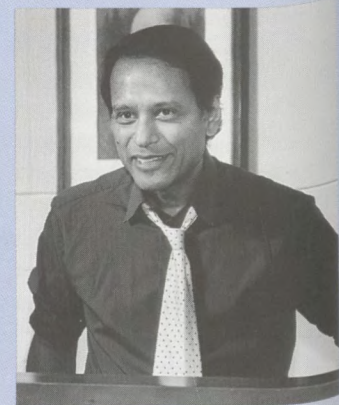
Although science, technical issues, and the formal process of drafting laws and negotiating agreements have received much attention, the crucial step in the entire process is implementation, Bell maintains. In helping to develop implementation plans that are realistic, IIDEA will give high priority to context—that is, to the condition of a country's legal system and economy, the maturity of its governmental bodies, the soundness of its institutional framework, and the capacity and willingness of its citizens and business enterprises to comply with a given law. Process is important, too, Bell says. Consensus-building, for example, can boost compliance. To reach it usually requires knowing how to set up a dialogue among the various parties affected by the laws in question.

Bell gained her expertise in building the institutions that undergird environmental policy and law during seventeen years at EPA. She spent most of her last six years at the agency

advising former Soviet Bloc countries on how to "activate" law to solve environmental problems arising from the political and economic changes in that region. For a time Bell was the resident advisor of the Regional Environmental Center for Central and Eastern Europe in Warsaw, Poland.

### Discounting scholar is university fellow

Partha Dasgupta, a professor of economics and philosophy at the University of Cambridge, is RFF's newest university fellow. He is also one of the most influential thinkers and writers on the often controversial tool called "discounting," which economists use to compare present with future benefits



Partha Dasgupta

and costs. Dasgupta accepted the invitation to become a university fellow from RFF President Paul R. Portney while participating in a workshop on discounting and intergenerational decisionmaking that RFF and the Energy Modeling Forum co-sponsored last fall.

RFF created its university fellowship program in 1988 to foster cooperative research between staff and leading academics around the world.

### Three join RFF board

The RFF Board of Directors swore in three new members at its annual meeting in April. They are **Catherine G. Abbott**, a natural gas and power executive; **James H.S. Cooper**, an investment banker and former member of Congress; and **Frank E. Loy**, a business executive, lawyer, and former senior government official.

Abbott is the CEO of two interstate pipeline subsidiaries of the Columbia Gas System, Inc., in Charleston, WV. With more than eighteen years of experience in the natural gas and power industries, she has long been a consultant to natural gas, electricity, and other energy firms, advising them on marketing, government relations, and merchant banking.

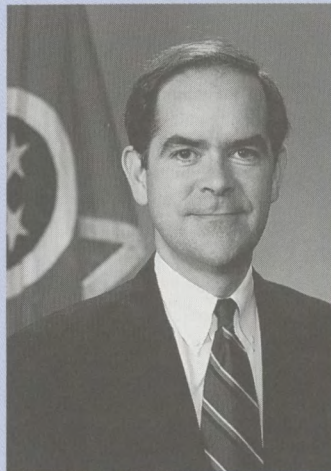


Catherine G. Abbott

As a vice president from 1985 to 1995 at Enron Corporation, she managed that company's national marketing of unregulated natural gas and established its first approach to trading and valuing natural gas locational price differentials. Before entering the private sector, Abbott directed a number of offices at the U.S. Department of Energy, making policy recommendations on deregulation of natural gas and electricity. She also served at the White House Office of Energy Policy and Planning and the Environmental Protection Agency. Abbott holds an M.A. in public policy from the John F. Kennedy School of Government at Harvard University and a B.A. with High Honors from Swarthmore College.

Cooper is the managing director of investment banking at Equitable Securities Corporation in Nashville, TN. Cooper served as a member of the U.S. House of Representatives (D-Tenn.) from 1982 to 1994, where he advocated such market-based environmental reforms as emissions trading programs. In 1994, he was Tennessee's Democratic nominee to the U.S. Senate. As a congressman, he was a member of the so-called "Group of Nine," instrumental in passing the 1990 Clean Air Act. Today he serves on the board of the Center for Clean Air Policy, among other organizations.

Before representing the fourth district of Tennessee,



James H. S. Cooper

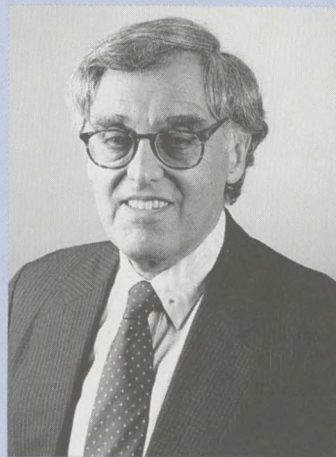
Cooper practiced corporate and securities law with the firm of Waller, Lansden, Dortch & Davis. He received a J.D. from Harvard Law School and an M.A. in philosophy, politics, and economics from Oxford University, where he was a Rhodes Scholar. He also holds a B.A. in history and economics from the University of North Carolina, where he was a Morehead Scholar.

Loy chairs the board of trustees of the League of Conservation Voters and is vice chair of the Environmental Defense Fund's board. His current scope of activities includes addressing economic and environmental issues both in this country and in Central and Eastern Europe and Germany. With the Monsanto Corporation's CEO Robert Shapiro, he co-chairs a committee advising the President and the U.S. trade representative on environmental policy and trade. He serves on the

board of the Regional Environmental Center for Central and Eastern Europe, Budapest, of which he is a founding member.

These activities follow a long career in business, government, and law, including much international engagement. From 1981-95, Loy was the president of the German Marshall Fund of the United States. He directed the U.S. Department of State's Bureau of Refugee Programs and was a deputy assistant secretary of state for economic affairs.

In the private sector, Loy successfully piloted the Penn Central Transportation Company out of bankruptcy. At Pan American World Airways he focused on international regulatory affairs as a senior vice president. He began his career as a corporate lawyer with O'Melveny & Myers, after receiving a B.A. from the University of California at Los Angeles and an L.L.B. from Harvard Law School.



Frank E. Loy



# ANNOUNCEMENTS

## RFF names 1997 award winners

Joseph L. Fisher Dissertation Awards are presented annually to support graduate students in economics and policy studies during the final year of their dissertation research on issues related to the environment, natural resources, or energy. These awards honor the late Joseph L. Fisher, who was president of RFF from 1959 to 1974.

This year RFF received 120 applications for the Fisher awards—more than twice as many as in previous years—suggesting that more young people in all types of fields are choosing to study issues related to natural resources and the

environment. The quality of the applications was excellent. Those selected represent a wide range of disciplines from engineering economics to zoology, and research interests from groundwater in India to Superfund issues in the United States. Each of the following individuals received a \$12,000 fellowship to support completion of the dissertation indicated:

- Navroz Dubash, Energy and Resources Group, University of California at Berkeley: "Pumping for Power and Profit: A Study of Groundwater Markets in Gujarat, India."
- Mark Stephan, Department of Politics, Princeton University: "Community Involvement in Superfund."
- Amy Craft, Department of Engineering-Economic Systems and Operations Research, Stanford University: "The Socially Optimal Level of Transmission Capacity in a Deregulated Electricity Market: A Technical Summary."
- Cristina Bellido, Department of Economics, University of Chicago: "Contributions to Environmental Interest Groups: How Much Information Do They Convey on the Valuation of Environmental Amenities?"
- Sandra Diamond-Tissue, Department of Zoology, North Carolina State University: "The Effects of Shrimp Trawl Bycatch on Atlantic Croaker."

## Ordering books and reports

To purchase books and reports, add \$3.00 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.

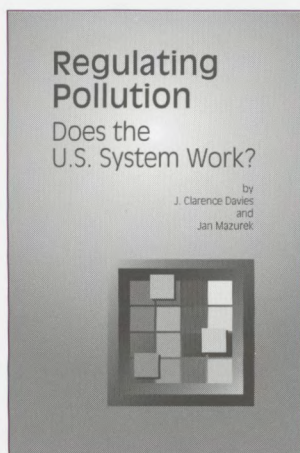
Please send a written request and a check payable to Resources for the Future to: Discussion Papers, External Affairs, Resources for the Future, 1616 P Street, NW, Washington, DC 20036-1400. Recent discussion papers are accessible electronically at <http://www.rff.org>.

## Regulating Pollution: Does the U.S. System Work?

By J. Clarence Davies and Jan Mazurek

What laws, processes, and institutions exist to protect the American environment? To what degree do they succeed? This important new book concisely describes and evaluates America's pollution control system. It concludes that "For all its accomplishments...the pollution control regulatory system is deeply and fundamentally flawed."

The authors, analysts with RFF's Center for Risk Management, examine the fragmented tangle of statutes, regulatory bodies, and programs designed to control environmental degradation in the United States. Davies and Mazurek employ carefully chosen criteria such as pollution reduction, economic efficiency, and respon-



siveness to social values in order to judge the effectiveness of the various instruments—and the system as a whole—in protecting the environment. The authors' goal is a critical understanding of pollution regulation in the United States, thus laying the groundwork for improving it.

*Regulating Pollution* emerges from a major research project undertaken by RFF's Center for Risk Management, with support from the Andrew W. Mellon and Smith Richardson foundations. The three-year project constitutes the first in-depth, systematic evaluation of U.S. pollution control efforts. This book summarizes the project's findings and makes them immediately available; RFF will publish the full report at a later date.

ISBN 0-915707-85-3 • approx. 56 pages • \$9.95 paperback



## DEVELOPMENT

### RFF's China Program Continues

With the death of Walter O. Spofford, Jr. last fall, RFF lost a dear friend and colleague. To many people, Walter was synonymous with RFF's work in China. He established the China Program at RFF in 1989 and oversaw the translation into Chinese of fifteen books outlining RFF economic analysis of environmental issues. In the field, Walter worked closely with Chinese officials at all levels to establish environmental standards compatible with sustainable economic growth goals. He was instrumental in developing environmental master plans for Beijing, Chungjing, and Shandong. In 1995, he helped establish the Beijing Environment and Development Institute (BEDI). Thanks to his tireless efforts, scholars at both RFF and BEDI have a solid platform for future endeavors.

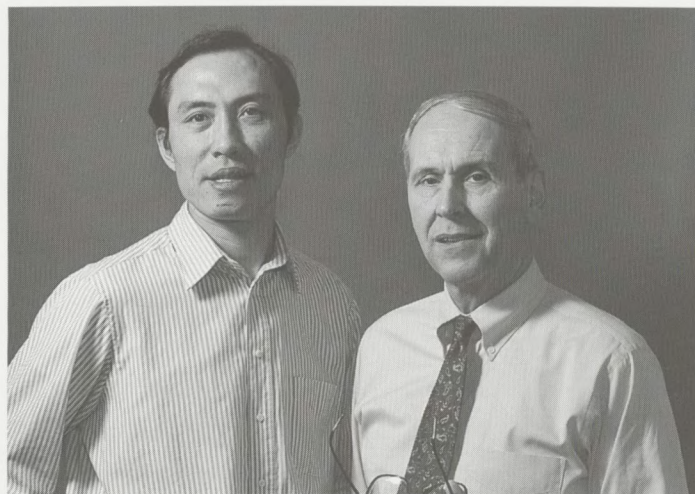
### A Memorial Internship

A key goal of the RFF China Program is in-country capacity building, and Chinese scholars have been intimately involved in all of the program's work including spending time at RFF honing their analytical skills. To continue this important work, RFF is establishing The Walter O. Spofford, Jr. Memorial Internship for Chinese students to pursue the study of environmental economics. The first of these internships is scheduled for summer 1997.

If you would like to help establish the internship—and celebrate Walter's legacy in a meaningful way—please contact RFF's development office. Or you may respond directly by sending a check payable to RFF, referencing your desire to support this memorial fund, to Resources for the Future, 1616 P St. NW, Washington, DC 20036.

As many readers of *Resources* know, BEDI was the first independent, nonadvocacy environmental research organization in the People's Republic of China. Today BEDI is a growing institution, dedicated to balancing China's economic needs with responsible environmental practices. BEDI scholars conduct research on a variety of issues, including environmental and natural resource economics; natural resources management and policy; and the application of economic, conservation, and sustainable development theories in China. In addition to this ambitious research agenda, BEDI's mission is to provide reliable and objective information to decisionmakers; foster awareness of sustainability issues in China; and promote cooperation between government, industry, and other organizations.

Climate change policy is an important part of BEDI's



*Professor Ma Zhong, president of BEDI and director of China's Institute of Environmental Economics, Renmin University, Beijing and Walter O. Spofford Jr.*

current research agenda. BEDI's experts have joined forces with their counterparts at RFF and at several institutions in Japan. In each country a research team is investigating options for reducing greenhouse gas emissions in cooperative ways that are mutually beneficial.

To help identify how multinational cooperative efforts might be structured, the three research teams are analyzing opportunities and obstacles to transferring and diffusing lower-emissions technologies in developing countries. They are also evaluating the potential for increasing the use of economic incentives to encourage industrialized countries to invest in those technologies.

Michael Toman, director of RFF's Energy and Natural Resources Division, is leading the collaborative research project. Milton Russell, former director of RFF's Center for Energy Policy Research, is

joining the effort as an adviser to the BEDI team. Over the last decade, Russell's work in China has concentrated on such sustainable development issues as environmental policy, preservation of ecosystems, environmental and energy management, and promotion and implementation of energy conservation and renewable energy projects.

Perhaps the project's major strength is the participation through BEDI of experts who are contributing to a better understanding of the issues and opportunities for international cooperation from a Chinese perspective. The project is expected to be completed by the fall of 1997 when researchers from the three countries will present their findings at a meeting in Beijing, China.

*RFF would like to offer special thanks to the Ford Motor Company for its strong and early support of BEDI.*



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RFF discussion papers convey to interested members of the research and policy communities the preliminary findings of research projects for the purpose of critical comment and evaluation. Unedited and unreviewed, they may be ordered from RFF (see page 22).

The following papers have recently been released:

- "Control of Dioxins from the Pulp and Paper Industry under the Clean Water Act and Lead in Soil at Superfund Mining Sites: Two Case Studies in EPA's Use of Science" by Mark R. Powell (97-08)
- "The 1987 Revision of the NAAQS for Particulate Matter and the 1993 Decision Not to Revise the NAAQS for Ozone: Two Case Studies in EPA's Use of Science" by Mark R. Powell (97-06)
- "The 1983-84 Suspensions of EDB under FIFRA and the 1989 Asbestos Ban and Phaseout Rule under TSCA: Two Case Studies in EPA's Use of Science" by Mark R. Powell (97-06)
- "The 1991 Lead/Copper Drinking Water Rule and the 1995 Decision Not to Revise the Arsenic Drinking Water Rule: Two Case Studies in EPA's Use of Science" by Mark R. Powell (97-05)
- "Environmental Priorities for the District of Columbia: A Report to the Summit Fund" by Terry Davies and Nicole Darnall (97-04)
- "Economic Values of Freshwater in the United States" by Kenneth D. Frederick, Tim Vandenberg, and Jean Hanson (97-03)
- "Stranded Costs, Takings, and the Law of Economics of Implicit Contracts" by Tim Brennan and James Boyd (97-02)
- "The 'Regulatory Compact' and Implicit Contracts: Should Stranded Costs Be Recoverable?" by James Boyd (97-01)
- "Environmental Amenities as Sources for Product Differentiation and Market Power" by Laura L. Osborne and V. Kerry Smith (96-37)
- "The Role of Health-Risk Assessment and Cost-Benefit Analysis in Environmental Decision Making in Selected Countries: An Initial Survey" by Janice V. Mazurek (96-36)

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