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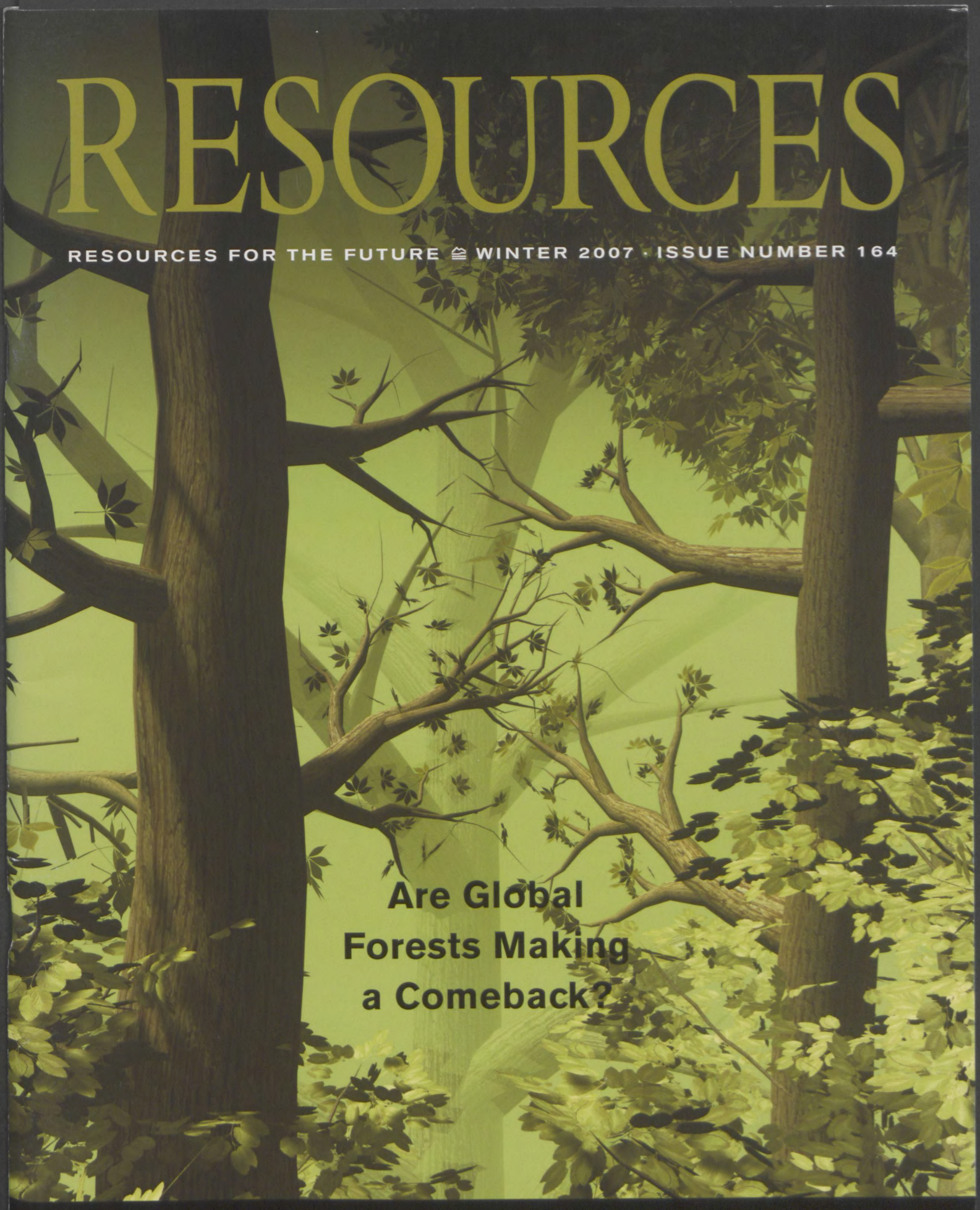

Are Global Forests Making a Comeback?

2006 ANNUAL REPORT

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Inside RFF

Thomas Schelling:
Developing Countries Will Suffer Most from Global Warming

In December, RFF hosted a presentation by Thomas C. Schelling, the 2005 Nobel Prize Laureate in Economics and a distinguished professor at the School of Public Policy, University of Maryland, at the Fourth Annual Hans Landsberg Memorial Lecture. Schelling was a colleague of Landsberg, who was a beloved member of the RFF research staff for many years.

Urging the audience to "be patient and not despair" when it comes to global warming, Schelling reminded the audience that relatively speaking, climate change is a new subject. "We're still trying to learn how to think about—especially to think collectively about, internationally—how to deal with global warming and the impending climate change and some of its consequences," he said.

The science behind the expectation of human-induced global warming is pretty well beyond dispute, Schelling said. "What there are, are many, many uncertainties: not so much uncertainty about whether global warming as a phenomenon is real, but uncertainties about how much warming there will be as a result of greenhouse gases; how that warming may change climates around the world; and how those shifting climates may affect human life, welfare, productivity, nature."

One important and immediate concern about global warming is that many tropical diseases, like malaria are likely to advance as tropical areas grow warmer and extend father.

Currently, malaria kills at least a million people a year, most of them children, Schelling said. "We have to think about the way that the world is going to look when climate change becomes very serious, likely in the second half of this century."

According to Schelling, a telling example of the interconnections between climate change and public health are the differences between Singapore and Malaysia, two countries separated by one kilometer of seawater. When Singapore separated from Malaysia about 40 years ago, they were identical in their development, and Singapore was essentially a mosquito swamp.

Singapore has now developed to where it probably has the highest standard of living in the world, not in terms of gross national product (GNP), but in the absence of poverty, the extent of home ownership, and the availability of health care, Schelling said. Malaria is essentially an imported disease in Singapore, brought back by travelers and quickly dealt with.

But the disease is widespread in Malaysia. If Malaysia can catch up to Singapore economically over the next decades, however, malaria can be brought substantially under control. A better health care infrastructure will mean that people can receive treatment and further transmission can be halted.

A second concern for Schelling is how global warming can affect

The real victims of climate change are going to be in the developing countries, where a third of the GNP may be agricultural and maybe half the population practices subsistence agriculture.

economic productivity and stability. In developed countries, the impact will be slight. Hardly any market-oriented production in the United States, Japan, Western Europe, or Australia is dependent on the weather.

The main exceptions are agriculture, forestry, and fisheries. But in the United States, they account for less than 3 percent of our gross domestic product. The question is not whether we will lose production of food, Schelling said. "The issue is whether food production will become much more expensive, whether the water will be much more expensive to deliver, and whether techniques of cultivation may require new kinds of machinery and maybe more labor—and that's leaving aside the fact that in the United States, we still generate agricultural surpluses.

"What we must recognize is that the real victims of climate change are going to be in the developing countries, where a third of the gross national product may be agricultural and maybe half the population practices subsistence agriculture," Schelling said. Probably the best way for them to defend against the adverse effects of climate change is to develop as rapidly as they can, he said. The sooner Malaysia can become like Singapore, the sooner it can worry less about the impact of climate change on health, comfort, and productivity.

"This leads me to conclude that the right way to think about climate change is primarily a foreign aid program," Schelling said. "The people who will benefit will be seven-eighths of the global population toward the end of the century. They are the people who need protection against climate change that they are not yet prepared for." ■

Managing Fish Portfolios

James N. Sanchirico, Martin D. Smith, and Douglas Lipton

Many fish stocks throughout the world are below biological target levels that ensure a sustainable population. Most of our knowledge about protecting and rebuilding overharvested fish stocks is based on efforts to protect a single species, such as the Chesapeake Bay blue crab. A common strategy is to place a limit on fishing for the species of concern. However, recent scientific advances in understanding how various species function and interact are leading to a new management paradigm that focuses on understanding the ecosystem in which the species of concern exists.

Marine scientists and policymakers are encouraging ecosystem-based fishery management, but there is limited guidance on how to put the concept into practice. In recent work on Chesapeake Bay fisheries, we have developed a method that accounts for species interdependencies, fluctuations over time, and sustainability constraints.

Our approach is loosely based on techniques employed in financial asset management. Investors used to focus on the risk (variance) and rewards (expected returns) of individual securities, similar to how fisheries are managed today. Portfolio theory shifted the perspective from choosing individual stocks to picking diversified portfolios, where taking into account the correlations across securities could reduce risks in order to yield the desired rate of return. Similarly, interdependencies between species, such as predator-prey or symbiotic interactions, mean that risks from harvesting each species can be correlated, making it possible to determine whether potential benefits could arise from jointly considering multiple fish stocks.

A portfolio approach to Chesapeake Bay fisheries management is a good fit for at least two reasons. First, Chesapeake Bay fishers are known locally as "watermen," reflecting their ability to earn a living off the water from a variety of activities. They are already manage their individual portfolios by harvesting a variety of species—including oysters, blue crabs, and striped bass—and employing different methods, such as tongs for oysters, various types of nets for finfish, and crab pots and dredges for crabs.

Second, Bay policymakers from Maryland, Virginia, Delaware, Pennsylvania, and the National Oceanic and Atmospheric Administration's Chesapeake Bay office have demonstrated interest in developing ecosystem-based fishery management plans. The latest update to the Chesapeake Bay Agreement includes a goal to develop such plans for target species, and the current Chesapeake Bay Fisheries Ecosystem Plan specifically calls for examining patterns of harvests as well as

incorporating uncertainty into fisheries management decisions.

Using readily available data on Chesapeake Bay fish catches and prices from 1962–2003, we derived an ecosystem frontier, a curve that plots the tradeoff between the variability of fishing revenues and the different levels of revenues (see figure below for an illustration of how this works). Minimizing this variability can be beneficial to fish processors, fishery-dependent communities, and individual fishermen, who may have boat and home mortgage payments but limited income outside of fishing. Furthermore, minimizing variability in fish populations, which is related to catch volatility, is an important ecological objective because less stable systems can lead to lower biodiversity.

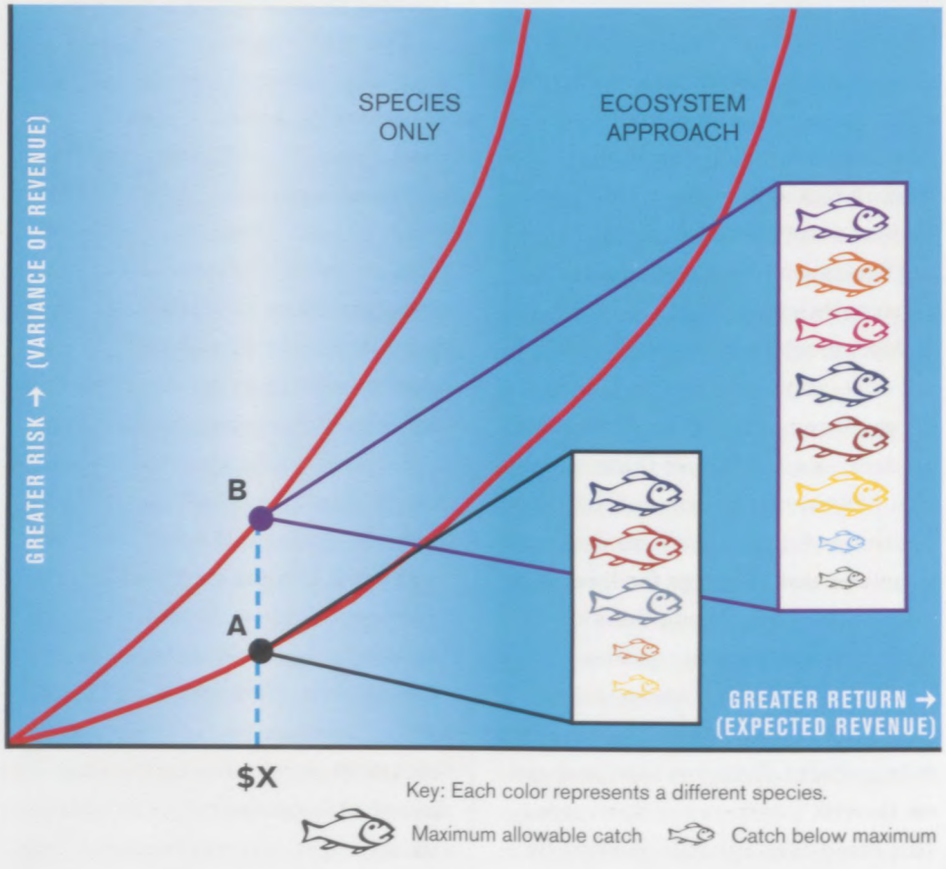
Our sample included the top 22 revenue-generating species: oysters, crabs, clams, snails, and finfish such as menhaden, striped bass, and blue fish. For low expected revenues, managers can diversify catches by completely curtailing total allowable catches for certain high-risk, low-return species. To reach a higher revenue target, however, managers must maximize the catch of more species. Each point on the frontier corresponds to a set of catch limits (see figure).

How does this compare to a single-species approach? Analyzing both an ecosystem frontier and a species frontier (which does not take into account the species interactions and is akin to how fisheries are for the most part managed today), we find that there are gains to be had. For example, for the same revenue target, the ecosystem approach can have considerably less variance (compare point A to point B). The inset to the figure also shows how different the recommendations for catch limits can be between the two approaches, where the single species approach more often relies on larger catches and includes a greater number of species than the ecosystem approach.

We also compared the actual revenues for each species in the Bay, (working from a subset of the larger sample) to the implied allocations from the ecosystem frontier and found that managers could have reduced the variability in returns. Preliminary analysis also confirms the structural change to the Chesapeake Bay ecosystem, in terms of species interactions, that resulted from the devastating oyster disease in the early 1980s, which dramatically reduced the oyster population.

A variety of other modeling methods are being developed for ecosystem-based fisheries management. Our portfolio approach complements this emerging suite of tools by incorporating, in a practical way, knowledge of the interactions of species within an ecosystem. ■

RISK-RETURN TRADE-OFFS



For an expected level of revenue of $X million, the ecosystem approach recommends point A and the species-only approach point B, which has greater variability than A. Each point on this representative frontier corresponds to a set of catch levels for the species in the ecosystem. We find, in general, that the species-only approach results in greater catches of some individual species and includes more species than the ecosystem approach.

This article is based on a forthcoming article in Ecological Economics, *"Ecosystem Frontiers: An empirical approach to ecosystem-based fishery management," by Sanchirico, Smith, and Lipton, and an RFF Discussion Paper, available on the RFF website at www.rff.org/Documents/RFF-DP-06-40.pdf. The authors thank the National Oceanic and Atmospheric Administration Chesapeake Bay Program for financial support through noaa Grant #na04nmf4570356.*

Siting Difficulty and Renewable Energy Development: A Case of Gridlock?

Shalini P. Vajjhala

Every social phenomenon eventually generates an acronym or two. Citizen opposition to new development is often foreshortened to NIMBY (Not in My Back Yard). When it comes to building new power plants and power lines, the uproar tends to be louder still with acronyms like BANANA (Build Absolutely Nothing Anywhere Near Anyone) entering the public debate. Few people like the idea of transmission towers marching across a verdant landscape, but the demand for new energy infrastructure, especially renewable energy facilities, has grown significantly in recent years.

Politicians on the national level see new renewable energy development as a means to achieve both national energy security and greenhouse gas reductions. And states and regions are beginning to focus on the local benefits of renewable energy, including potential improvements in state electricity reliability, local job creation, and regional economic growth.

To respond to these anticipated benefits, states and regions across the United States have launched a variety of programs and initiatives. Some of the most widely recognized are renewable portfolio standards (RPS), policies that require electric utilities to generate or purchase a minimum amount of electricity from renewable resources. How to fulfill this mandate varies from state to state: some RPSs specify which technologies are allowed, which must be used in certain amounts and from where, while others are more flexible. To date, RPSs have been enacted or renewed in 22 states and the District of Columbia.

Despite gaining a great deal of momentum in recent years, such efforts still face huge obstacles—primarily, where do we build these new facilities? A recent illustration of the severity of siting problems is Cape Wind, a proposal to site 130 wind turbines off the coast of Massachusetts in Nantucket Sound. This proposal has moved slowly forward through years of regulatory and environmental assessments and high-profile public and political opposition, most notably that of the Kennedy family.

Although Cape Wind is an extreme example, many of the problems surrounding this project are common to other renewable energy facilities, which generally face hurdles above and beyond their conventional counterparts. Not only are renewable resources typically confined to pristine, isolated parts of the country, like mountain tops or coastal waters, but these resources are also inflexible. Unlike conventional energy facilities, such as coal or natural gas power plants, where the fuel can be moved to the power plant, renewable fuels are immobile, and electricity must instead be moved out from these areas.

As a result, the viability of any new large-scale, grid-connected renewable energy project depends not only on the locations of renewable resources but also on the availability of supporting infrastructure, such as transmission lines. Because renewable resources are so often confined to remote locations, in many cases they also require new electric transmission lines to ship power to areas where it is needed. Consequently, renewable energy developers are faced with a chicken-and-egg problem. Without adequate and accessible transmission capacity, renewable projects are unlikely to cross the threshold of economic viability, and without adequate generation capacity to justify new transmission construction, investment in new lines also is unlikely to occur.

Mapping Siting Difficulty

Transmission-line siting difficulty provides an important benchmark for the siting problems facing new renewable energy development. Therefore, one way to evaluate this obstacle is to compare areas with different amounts of renewable resource *potential* to areas of anticipated transmission-line siting difficulty. This analysis can then be used to examine the potential barriers to effective implementation of policies to promote renewable energy development, such as Renewable Portfolio Standards.

In a recent article in *Energy Policy*, Paul Fischbeck, a professor at Carnegie Mellon University, and I developed a measure of transmission-line siting difficulty for the continental United States based on several measures, including the economic variations of the cost of electricity generation within states, proximity of residents to power plants in different states, comparisons of power plant and power line construction over time, and perceptions of

siting difficulty in different states, gathered through a survey of industry siting experts.

The results of our analysis are illustrated in Figure 1. On this map, each state has a siting difficulty score between -3 and +3, where zero is the average siting difficulty across the United States. States with below-average siting difficulty, those shown in the lighter colors on the map, have negative scores, and those with greater than average difficulty, the darker states, have positive scores. Given these variations in power-line siting difficulty, what are the implications for new renewable energy development?

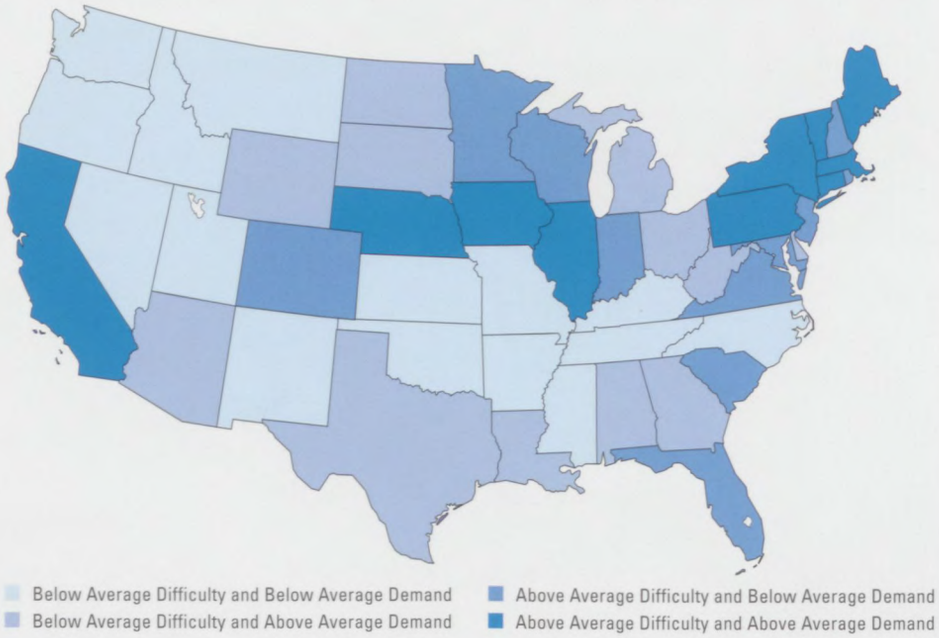


Figure 1. Difficulty in siting transmission lines varies from state to state as does the need or demand for additional transmission capacity.

Comparative Spatial Analysis

To examine the extent to which transmission line siting difficulty might affect the development of different types of renewable energy resources or constrain the implementation of policies such as RPSs, I used geographic information system (GIS) data to compare the measure of transmission-line siting difficulty with the spatial distribution by state of four common renewable resources—wind, solar, geothermal, and biomass. Using maps and data from the National Renewable Energy Laboratory and the Department of Energy, a standardized measure of resource *potential*, an area-weighted average of each resource, was calculated by state. For example, for the case of wind power, this average was developed based on wind-power classes or measures of wind speed. Using GIS, the total area within each power class for every state was calculated to find the average power class for an entire state. For example, Mississippi, which is entirely in the wind power class 1, has an average wind power class of 1. In contrast, Colorado, which spans multiple power classes, has an average of 3.47.

Solar-power potential was calculated using a similar method based on average daily value of the incoming solar radiation that reaches any object exposed to solar rays, such as photovoltaic panels. Geothermal energy, which is contained underground as reservoirs of steam, hot water, and hot dry rocks, relies on the extraction of heat as steam or hot water to power steam turbines and generators to produce electricity. The measure of potential for this resource is the average subsurface temperature at a depth of 6 kilometers. Finally, total state biomass potential was calculated based on estimates of the technical potential biomass resources currently available in the United States by county (dry tons per year), including crop residues, manure, forest and mill residues, and landfill and wastewater-treatment gases.

Widespread Potential

The good news from this analysis is that renewable resource potential is widespread. Across the continental United States, 43 out of 48 states have above-average renewable resource potential for at least one resource and 28 states have above-average potential for two or more resources. This is not to say that certain regions are not more favorable for certain types of renewable energy development, or that development of all resources in each state is economically viable—but this result highlights that there are few areas where renewable energy is not an option.

The bad news is that states with some of the greatest motivations to develop in-state renewable energy have less resource potential and face higher siting difficulty than other states.

Take states that are net importers of electricity, such as California, New Jersey, and Maryland. These states have higher electricity prices than the national average and could potentially benefit from the local economic benefits and improved electric reliability possible through intrastate renewable resource development; however, importing states not only have less average resource potential, but also significantly higher siting difficulty than exporting states. As the first three

graphs of Figure 2 show, the 18 importing states have slightly less wind and significantly less solar and geothermal resource potential than the 30 exporting states. Only in the category of biomass resources do importers have a slight, but statistically insignificant advantage over exporters. These results highlight the potential barriers to within-state renewable resource development and raise the question of whether high prices and possible reliability benefits will provide sufficient incentives within any given state for those states to turn to renewable energy as a response.

One possible mitigating factor is the role of state RPSs. Evaluating the spatial distribution of resource potential in states with RPSs relative to those without reveals that average resource potential is not significantly different across these states. However, the states with RPSs currently in place still have significantly higher transmission siting difficulty than those without. Although RPSs are intended to encourage investment in and construction of renewable energy facilities, significant siting constraints could increase uncertainty and reduce the incentives to meet these standards with local resources, thereby shifting some of the anticipated benefits, such as local economic growth and job creation, to other states from which renewable energy can more easily be generated (as credits) or imported.

Conclusions

Taken as a whole, many incentives exist for state-level renewable energy development; however, policy proposals toward this end often focus on structures to promote investment and not on interventions to mitigate siting difficulty. As a result, siting difficulty facing both renewable energy power plants themselves and related transmission lines could significantly affect states' ability to meet renewable energy goals and limit their ability to take advantage of potential local economic benefits. For renewable energy to make significant strides toward displacing conventional energy facilities, siting difficulty and its relationship to renewable resource potential must be given much higher priority.

One example of the type of policy intervention that could address these constraints are provisions in the Energy Policy Act of 2005 for "energy corridors" on federal lands in the West and national interest in electric transmission corridors. Including evaluations of renewable resource potential and possible transmission demands as explicit criteria in such a planning process could significantly help start and support new renewable energy development.

Waiting until push comes to shove—that is, until rising costs of conventional fuels spur widespread and rapid growth of new renewable energy facilities in the larger competitive market—presents its own dilemma. Because some renewable energy technologies and projects are still uncertain and many facilities currently take longer to permit and build, in a crisis, there will be little motivation to turn quickly to renewable capacity, unless large-scale commercial applications have already been sufficiently tried, tested, and proven. As a result, addressing siting constraints and solidifying opport unities for effective, early renewable energy development are important initial steps toward meeting long-term energy security and emissions reduction goals. ■

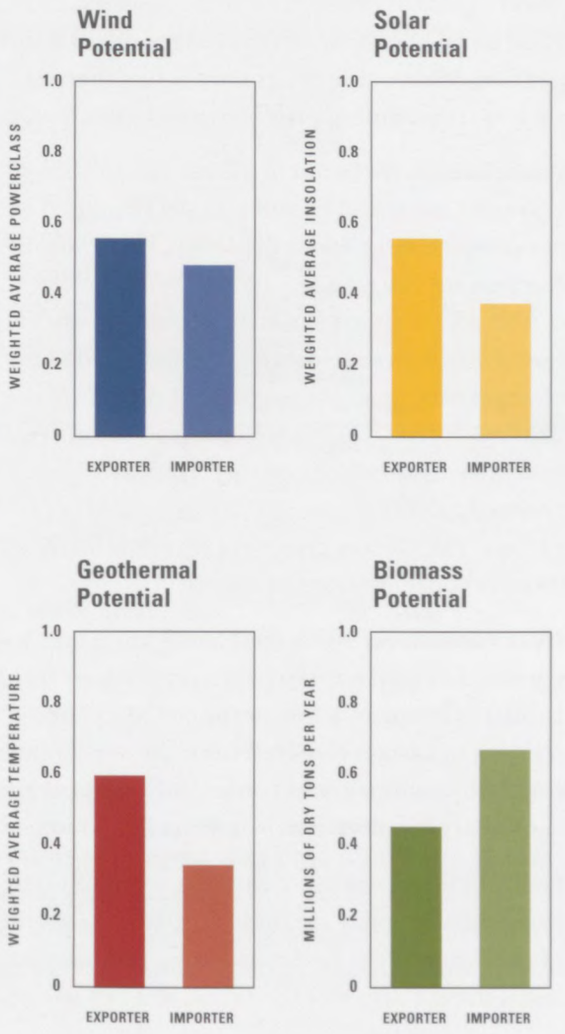


Figure 2.
The average resource potential of different kinds of renewable energy available in net electricity importing states is significantly different than that in net exporting states. Importing states have significantly higher solar and geothermal potential relative to exporting states.

Are Forests Making a Comeback?

NEW FINDINGS SUGGEST OPTIMISM ON GLOBAL OUTLOOK

A paper published recently in the Proceedings of the National Academy of Sciences *offers new evidence that the world's forests, particularly in developed nations, are gaining ground and may even be returning to a healthy, restored condition. These findings—which seem counterintuitive in the wake of clear cutting, commercial exploitation, and environmental damage in global forests over the last half-century—have generated hope that forest declines can be reversed.*

Three of the authors of this paper, Roger A. Sedjo, a senior fellow at RFF; Pekka E. Kauppi, professor of environmental science and policy at the University of Helsinki; and Jesse H. Ausubel, director, Program for the Human Environment, of The Rockefeller University and an RFF University Fellow, sat down with Resources *to discuss their research and its possible implications. Their conversation follows.*

Roger Sedjo: Our study discovered that since 1990, tree stock has increased in 22 of the world's 50 most densely forested countries, and most of those are developed nations. That is good news, of course, but overall the world is still losing forests—about 39,000 square miles per year. What our findings show is that there are policy measures that can reverse this trend, such as tree-planting programs and better forest management.

Pekka Kauppi: We found in a sense two worlds—69 countries with increasing forests between 1990 and 2005, and 92 still with decreasing. If we discount Brazil and Indonesia, which have experienced large forest depletion, then globally the forests of the world increased by about two percent since 1990.

Forests are always in a state of change—they are living ecosystems, after all. One of the innovative features of our study is a new kind of measurement, called "forest identity," to track changes over time. We aggregated data from the United Nations Food and Agriculture Organization (FAO) for more than 200 countries. Rather than just count trees or take photos from above, we calculated each country's "growing stock," those trees mature enough to be counted as timber. We did this by measuring the volume of timber, biomass, and captured carbon. The carbon capture of forests is increasingly important because it affects the carbon dioxide concentrations in the air.

Jesse Ausubel: Forests resemble the blind men's elephant. Some people look at a forest and see wood to convert into paper products or furniture. Others consider the spatial area, the habitat, the square kilometers needed to harbor deer or tigers. Some look at the forest and see tons of carbon removed from the atmosphere. Using the forest identity, we provide one equation that integrates consistently all these major views of the forest. It offers a common vocabulary for diverse stakeholders for forests.

Sedjo: In forest surveys of the past, we were pretty limited to a one-dimensional data set. The data available today are multi-faceted. The forest area might be constant, but the condition of the forest might be deteriorating or improving. The forest identity approach allows us to assess the condition of the forest, not just its size.

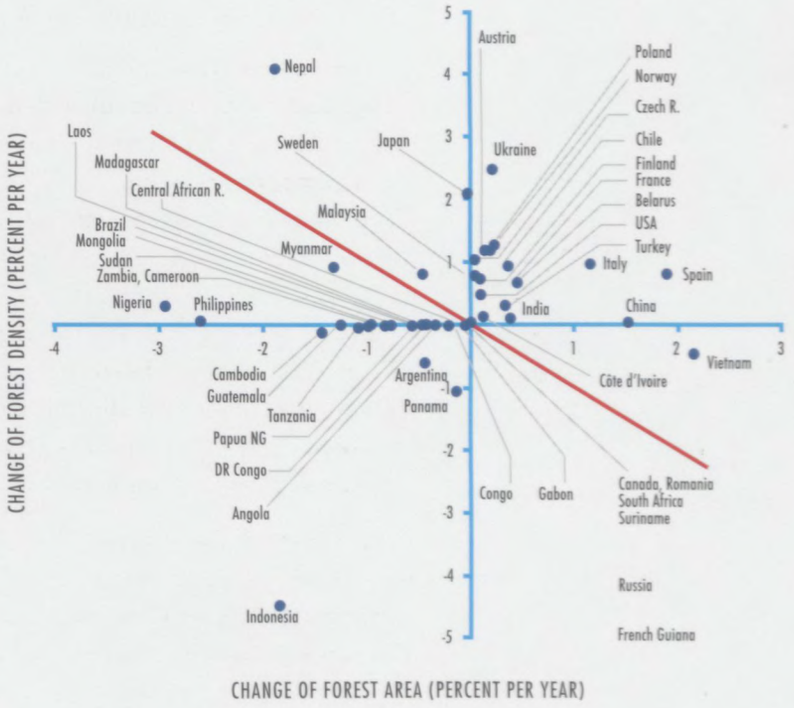
Kauppi: We know that as nations grow and develop, their forests shrink. And then, at some point in history, forests suddenly start to expand, a point called forest transition. In this study, we mapped these changes across the United States, Europe, and Asia and found that the shift from shrinking to expanding forests occurs through the continents. And we have an optimistic view that other areas will eventually experience this forest transition as well, perhaps in a few decades. However, we can't forget that overall deforestation is continuing, and at the current rate of forest decline worldwide, we will lose all our forests in 300 years.

Ausubel: Each of us recognized, perhaps 10 to 15 years ago, that forest transition was taking place in the United States, Scandinavia, and a few other regions. The availability of the new FAO data set enabled us to look at the period 1990 to 2005. And I was surprised that 22 of the 50 countries with the most forests now have increasing volume. When we look at all 214 countries, we find that 69 of 214 countries, including those with smaller forest areas, have increasing forests.

The number of countries and the extent of the transition did surprise us. All the European nations, except perhaps Estonia, have increasing forests. We were surprised that places like India, China, Turkey, Ukraine, Tunisia, Vietnam, and Malaysia added area or volume between 1990 and 2005. If you had asked me as a young environmental scientist back in the late 1970s whether India or China would have increasing forests by 2005, I would have said no. I would not have expected the transition to occur as early as it has. On the negative side, Indonesia is a tragic outlier in rate of loss of both area and density, and Nigeria and the Philippines also are rapidly losing area. Brazil's rates are not that high, but the absolute loss is huge, tying Indonesia for the worst, because Brazil's base is so large. The forest identity helps us recognize where action is needed to hasten the forest transition and shows diverse successful paths.

Figure 1.
A Global Chart of How Forests Have Changed in Area and Density, from 1990–2005

This chart displays how forests are changing in the the 50 countries with the most growing stock in 2005. The higher a country appears on the chart, the faster its forest area expanded. The farther to the right one appears, the faster its forest density grew. And, the farther to the right of the red diagonal line, the faster its volume of growing stock increased. Examples include China, India, Italy, Spain, and Vietnam, which have diverse climates and degrees of wealth.



Sedjo: People ask us why reforestation occurs. The study confirmed a relationship between per capita income in countries and forest expansion. Environmental economists know that initial increases in per capita income are associated with the deteriorating environmental quality—and then there's a point at which it levels off as income increases. As income rises and countries become wealthier, we see environmental quality improving. We found something very similar with forestry. None of our 50 most forested countries with a per capita income of $4,600 or more had experienced deterioration in their forests. They were all either constant or positive, one of our most interesting discoveries.

Now, at below $4,600 per capita, we got a whole array of performances. China and India, big countries with large forests, showed a positive improvement in their forests. But Brazil and Indonesia, also big countries with large forests and lower per capita incomes, showed a loss. So at below $4,600, other factors were clearly working.

Kauppi: Another major concern about forests is the impact they have on climate change. Forests absorb carbon from the air, and carbon sequestration is one result of the capture of greenhouse gases by trees. If you have more biomass in forests, you have less carbon to warm the air. Certainly we believe that reforestation will help curb the accumulation of carbon dioxide in the earth's atmosphere.

Ausubel: But an offsetting consideration may be at work here, the albedo effect. Forests in general are dark, and dark surfaces absorb heat; light surfaces, like deserts, reflect more and, from the point of view of physics, are cooler. Some analysts look at the difference in reflectivity and estimate the offset in heat retention could be substantial in relation to the amount of carbon that the forests hold. It's an old idea that is getting renewed attention. Improved history of the albedo effect could change our calculations of the planet's climate history.

Sedjo: I think there's something to that. If albedo is important, then it should be built into some of the general circulation models that predict temperatures and climate conditions around the world. And it sounds as though there are some new scientific findings that would raise questions about both the future and the past.

Ausubel: Yes, it could mean the big numerical simulations of climate aren't accounting as accurately and as fully as they should for what's happened historically. Ironically, deforestation may have contributed less to global warming than usually stated.

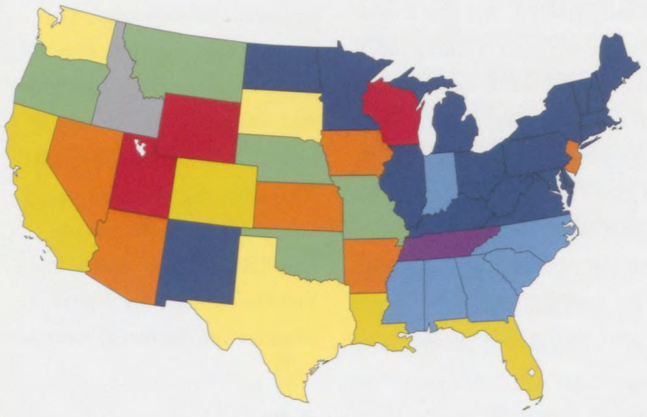


Figure 2.
The Historical Transition from Deforestation to Reforestation Across the United States

When forests that have been cleared are allowed to regrow, the turning point is called a forest transition. The dark to light colors indicate the spread of the transition across the country and each color corresponds to the date when the smallest amount of forest area was reported. Before 1800, European settlers had cleared a comparatively modest area, but during the following decades, they cleared more than in the previous 250 years of settlement. Although the rate of change after 1920 has been more modest, regional transitions have occurred across the country.

Sedjo: Another issue that came up was the difference between deforestation in the temperate and northern boreal zones, as opposed to the tropics, which have warmer air that holds more moisture. And evaporation from forests in warm areas forms clouds that tend to cool the earth.

Ausubel: The history of land cover, at least for the last 200 years, needs to be reconstructed in detail. There should be, maybe decade by decade, snapshots of Earth's land cover from 1800 to the present, with the reconstructed albedos and the possibility of including the related moisture feedbacks.

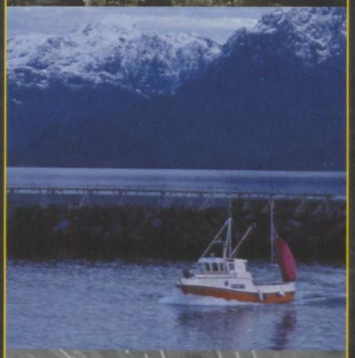
Sedjo: So what do our findings suggest about what can be done to reverse deforestation? Should we be concentrating on saving natural forests or nurturing plantation forests?

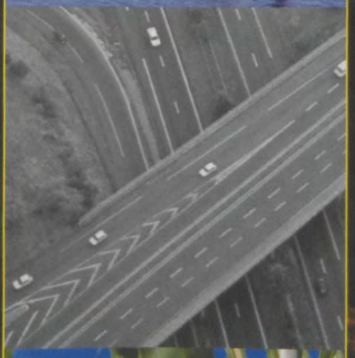
Kauppi: We should do both. Governments can play a big role, as well as private companies and even individuals. Systematic tree planting and better forest management can help us achieve sustainable forests, but the biggest factor is prosperity. When nations have higher incomes, their people pay more attention to preserving nature. They protect trees from fire and insects and other threats. No one wants to lose forests if society has the means and capability to follow more sustainable behavior.

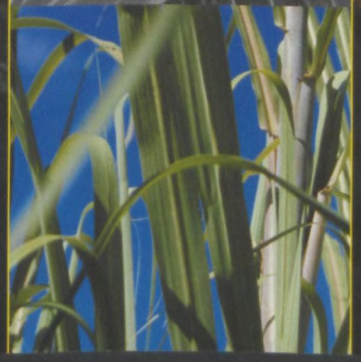
It's also necessary to distinguish between young and mature forests. We know that carefully cultivated young tree plantations can provide most if not all of the commercial timber we need, and leave the older forests relatively undisturbed and protected from logging.

Ausubel: Some risks rise with the return of forests, to be sure. For example, Spain and Portugal had little forest for the last 500 years, so they had few forest fires. Since much of their forest has regrown, in recent years they have had huge fires. And people living near expanding forests notice a large increase in wildlife—deer, bears, even cougars or mountain lions. As New England's forests have regrown, residents have suffered a spread of Lyme disease from deer ticks.

Sedjo: The study shows that the condition of forests is dynamic, and that in many countries the forests are expanding, healthy, doing well, and there are lots of benefits that flow from this. And forests in countries that are having problems are not beyond correction. The fact that we have a chance for massive reforestation of the earth in the 21st century is wonderful, and we should seize it. ■







Resources for the Future

2006 Annual Report

A Message from RFF's Leadership
Impact through Research

A year of reflection and hard thinking about RFF's institutional priorities has reaffirmed that our research base remains both viable and robust at a time when crucial policy choices confront the nation. We can assert with confidence that Resources for the Future will continue to fulfill its mandate to provide practical, credible, and innovative policy solutions to improve public decision-making around the world.

Scrupulously independent and nonpartisan—and anchored in research rather than ideology—RFF has maintained a standard of excellence for more than a half century. Today, it is poised to extend that role in the years ahead.

To remain a dynamic institution, of course, requires occasional course corrections to keep RFF in the forefront of academic advances and allow creative minds to pursue research wherever it leads.

Accomplishing these goals means that RFF's management and research team will rededicate themselves to:

- Help resolve perplexing or contentious issues in the management and oversight of energy, the environment, and natural resources.
- Continue to emphasize economic and quantitative social science in our research agenda.
- Maintain the reputation of RFF as a nonaligned institution that bears no ideological edges.
- Generate a public perspective for our findings through effective outreach to targeted policy audiences.
- Craft and implement equitable, feasible, and prudent policy prescriptions that take into account cost-benefit tradeoffs, valuation, and risk analysis.
- Create new knowledge, through rigorous scholarship, that can be applied nonjudgmentally to improve the public welfare and promote institutional enhancement.
- Take critical roles in convening activities designed to enlighten and inform conscientious policymakers.

Taken together, all these goals will constitute a concerted effort to increase the cumulative *impact* of RFF research.

Our recently completed Strategic Review mandates longer-term structural changes that will necessarily take place over several years. However, we also identified a number of more immediate needs that we believe can be addressed quickly. Among these are a new commitment to priority setting, the establishment of core research areas, and reorientation of internal incentives to increase the impact of individual researchers.

Clearly, RFF must be faithful to the principles that guided our work at our founding—a time of post-war challenges that seemed onerous, if not insurmountable. While the long-run critical challenges have evolved, they remain as forceful benchmarks for our research. With regard to RFF's strategic objectives, let us cite a selection of focal points to illustrate.

Today's critical concerns involve such areas as climate change, fishery viability, energy efficiency, antibiotic resistance, ecosystem collapse, and forest sustainability. In each of these areas, RFF research is evaluating a range of options to guide policymakers at the National Science Foundation, U.S. Environmental Protection Agency, National Institutes of Health, the National Academy of Sciences, and state agencies from New York to California.

At the same time, RFF is committed to maintaining its status as the single best source of high-quality social science analysis of current environmental and natural resource regulatory policy. One notable example is a recent book that assesses voluntary approaches in Europe, Japan, and the United States to encourage companies to improve their environmental performance. RFF researchers also consult regularly with the Office of Management and Budget on the cost–benefit tradeoffs of proposed regulations.

RFF remains the go-to source of reasoned and dispassionate analysis of complex environmental and natural resource issues. Evidence is seen in an overview in *Resources* magazine on the often-misunderstood issues surrounding oil supply, prices, and security—and available alternatives to petroleum. Public and off-the-record seminars have soberly looked at climate policy options in the private sector, offered a long-term perspective on global warming by Nobel Laureate Economist Thomas Schelling, examined China as a rising geopolitical presence, and provided a focused critique of policies on fuel-economy standards.

Through this process, RFF will be intentional and unapologetic about its efforts to enhance intellectual leadership in environmental economics. This comes to fruition most evidently in the nine seminal papers that were selected from nearly 200 submissions from around the world for the February 2007 Frontiers of Environmental Economics conference. It can be seen in the methodologies being crafted at RFF to measure the benefits of ecosystem services to the nation and the world. And it is demonstrated in the intricate models of land use, transit systems, population, and regional development being perfected for the national capital area and other fast-growing regional economies.

RFF President Phil Sharp (left), and Board Chair Lawrence H. Linden.

To be sure, RFF seeks to promote policy innovation without lapsing into advocacy—from "safety-valve" mechanisms to regulate environmental controls, to policies that would zone the oceans to protect natural habitats, to pricing and tax measures that would alleviate road congestion and deter alcohol and tobacco abuse.

We also resolve to enhance RFF's role as a convener, make better strategic use of our public platform, pursue partnerships with counterpart institutions, and communicate our results in the most effective ways to our policy audiences.

We are acutely aware that that evidence of our success will become more apparent only as we implement this vision. We also are aware that change carries necessary risks and can have unintended consequences. We will be vigilant in monitoring any potential threats to our financial viability, to our relationship with partners and other stakeholders, and to the substance or perception of our long-earned reputation.

To those of you interested in our work, and especially to those of you who help make it possible, our sincerest thanks. We invite you to participate in our progress.

Philip R. Sharp
President

Lawrence H. Linden
Chair

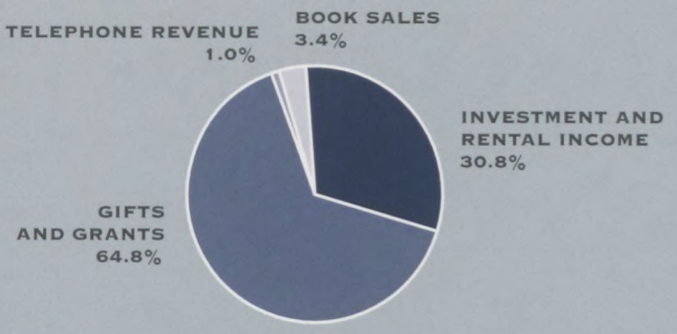
Financial Statements

ASSETS *Year Ended September 30*	2006	2005
Current Assets		
Cash and cash equivalents	$ 115,506	$ 331,077
Grants and contracts revenue receivable	657,714	513,023
Contributions receivable	1,182,363	537,050
Receivable from RCC	37,602	156,434
Other receivables	688,456	570,051
Prepaid expenses	—	3,032
Other assets	442,205	504,038
Total current assets	**$ 3,123,846**	**$ 2,614,705**
Contributions receivable, net of current portion	**$ 441,043**	**$ 26,090**
Investments		
Investments at fair value	35,572,987	35,244,118
Investment in land	8,900,000	8,900,000
Investment in RCC	3,900,152	4,623,638
Total investments	**$ 48,373,139**	**$ 48,767,756**
Fixed assets–operating–net of accumulated depreciation	**6,959,954**	**7,234,327**
Assets held under charitable trust agreements	**$ 462,830**	**$ 441,106**
TOTAL ASSETS	**$59,360,812**	**$ 59,083,984**

LIABILITIES AND NET ASSETS *Year Ended September 30*	2006	2005
Current liabilities		
Tax exempt bond financing, current portion	$ 190,000	$ 180,000
Grants and awards payable	33,750	23,327
Accounts payable and accrued liabilities	1,603,031	1,644,775
Deferred revenue	179,324	540,020
Total current liabilities	**$ 2,006,105**	**$ 2,388,122**
Tax exempt bond financing, current portion	**6,755,000**	**6,984,914**
Liability under split interest agreements	**549,823**	**568,075**
Funds held for others	**86,482**	**94,150**
TOTAL LIABILITIES	**9,397,410**	**10,035,261**
Net assets		
Unrestricted	42,224,369	42,360,973
Temporary restricted	1,934,132	1,305,559
Permanently restricted	5,804,901	5,382,191
TOTAL NET ASSETS	**49,963,402**	**49,048,723**
TOTAL LIABILITIES AND NET ASSETS	$ 59,360,812	$ 59,083,984

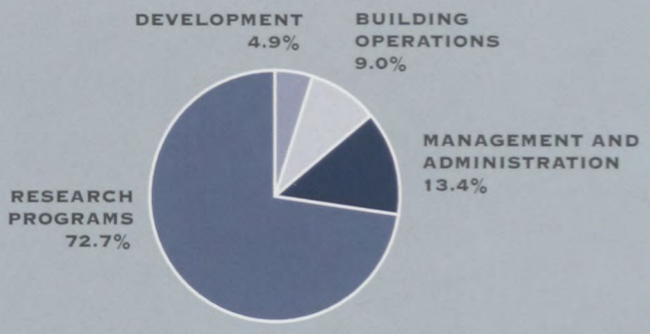
In the near future, biofuels will have to stand on their own without the large subsidies they are now enjoying, if only to protect the U.S. Treasury and taxpayers from ballooning subsidy payments.

Raymond J. Kopp, *Resources*, Fall 2006



REVENUE

In fiscal year 2006, RFF's operating revenue was $10.6 million, 64.8 percent of which came from individual contributions, foundation grants, corporate contributions, and government grants. RFF augments its income by an annual withdrawal from its reserve fund to support operations. At the end of fiscal year 2006, the reserve fund was valued at $35.6 million.



EXPENSES

RFF research and educational programs continued to be vital in 2006, representing 72.7 percent of total expenses. Management and administration, and development expenses combined were only 18.3 percent of the total. The balance is related to facilities rented to other nonprofit organizations.

STATEMENT OF ACTIVITIES *Year Ended September 30*	2006	2005
CHANGES IN UNRESTRICTED NET ASSETS		
REVENUE		
Individual contributions	$ 665,955	$ 327,795
Foundation grants	879,323	1,548,267
Corporate contributions	1,883,520	1,029,000
Government grants and contracts	2,535,865	2,124,480
Other institution grants	896,605	859,717
Rental income	1,754,990	1,888,798
Investment income net of fees	1,507,315	1,215,584
Telephone revenue	106,620	100,374
Book sales	362,429	343,048
TOTAL OPERATING REVENUE	**$ 10,592,622**	**$ 9,437,063**
EXPENSES		
Programs		
Research	$ 6,618,050	$ 6,149,003
Academic relations	254,667	239,063
RFF Press	600,041	603,102
Communications	962,121	874,581
Other direct	425,824	(146,545)
Total program expenses	**$ 8,860,703**	**$ 7,719,204**
Fundraising	595,826	609,282
Management and administration	1,637,197	1,701,762
Building operations and maintenance	1,096,541	912,064
Total functional expenses	**$ 12,190,267**	**$ 10,942,312**
Change in unrestricted net assets from operations	(1,597,645)	(1,505,249)
Non-operating revenues (expenses)		
Realized gain on investment transactions	2,799,551	1,450,067
Unrealized gain (loss) on investment transactions	(363,741)	1,398,310
Realized gain from sale of RCC interest	—	17,639,866
Other	76,514	—
INCREASE (DECREASE) IN UNRESTRICTED NET ASSETS	**914,679**	**18,982,994**
NET ASSETS AT BEGINNING OF YEAR	**49,048,723**	**30,065,729**
NET ASSETS AT END OF YEAR	**$ 49,963,402**	**$ 49,048,723**

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Top row, from left: Charles Kalmbach, Preston Chiaro, Michael Mantell, Michael Bean

Middle row, from left: Daniel Esty, Dod Fraser, Vicky Bailey, Kathryn Fuller, Matthew Simmons

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Since its founding in 1991, the RFF Council has recognized corporations and associations that contribute at least $25,000 annually to RFF and individuals who contribute at least $5,000 annually to RFF. These organizations and individuals all share RFF's interest in improving the environmental and natural resource policy debate—and their contributions provide much of the general support required to run the day-to-day operations of RFF. We wish to thank and recognize our 2006 Council Members. This year we have added nine new Corporate Members and six new Individual Members.

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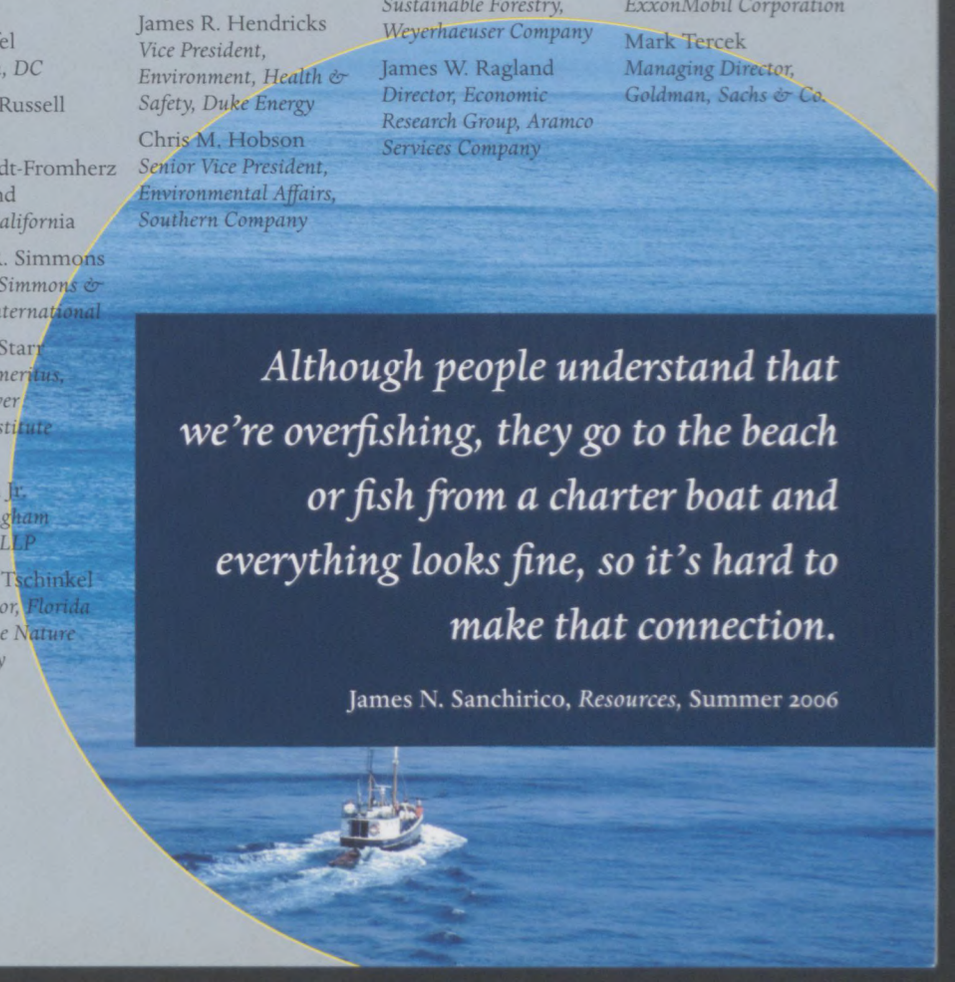

Although people understand that we're overfishing, they go to the beach or fish from a charter boat and everything looks fine, so it's hard to make that connection.

James N. Sanchirico, *Resources*, Summer 2006

Without bold and innovative measures that change the incentives to ensure that existing drugs are used judiciously and that the pipeline of new drugs is full, our future ability to fight diseases, both noninfectious and infectious, stands in peril.

Ramanan Laxminarayan
Extending the Cure Executive Summary

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RFF is grateful for the generous contributions it receives in support of its research and public education efforts and wishes to acknowledge and thank those individuals who have contributed $100 or more and who believe in the goals and mission of the institution and financially support its work.

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The Legacy Society recognizes those individuals who have generously made provisions for RFF in their estate plans. These gifts will help ensure the long-term vitality and financial strength of the institution.

Victoria J. Tschinkel, Chair

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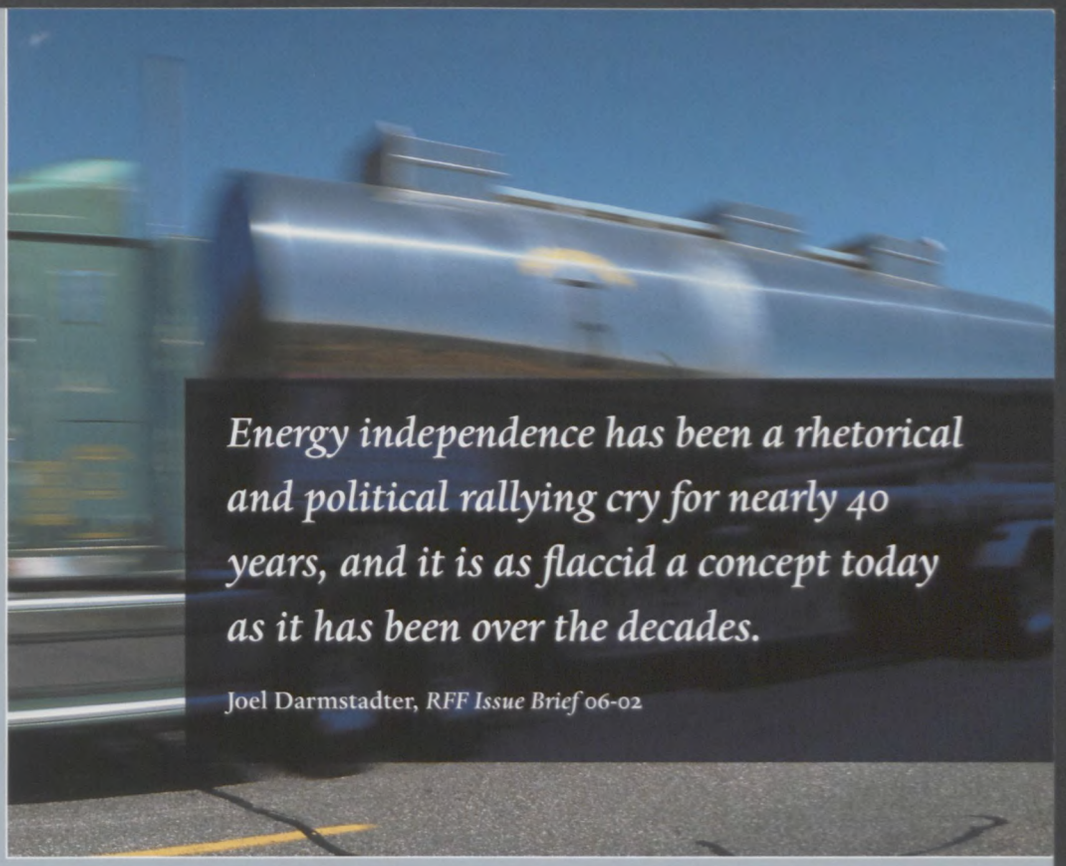
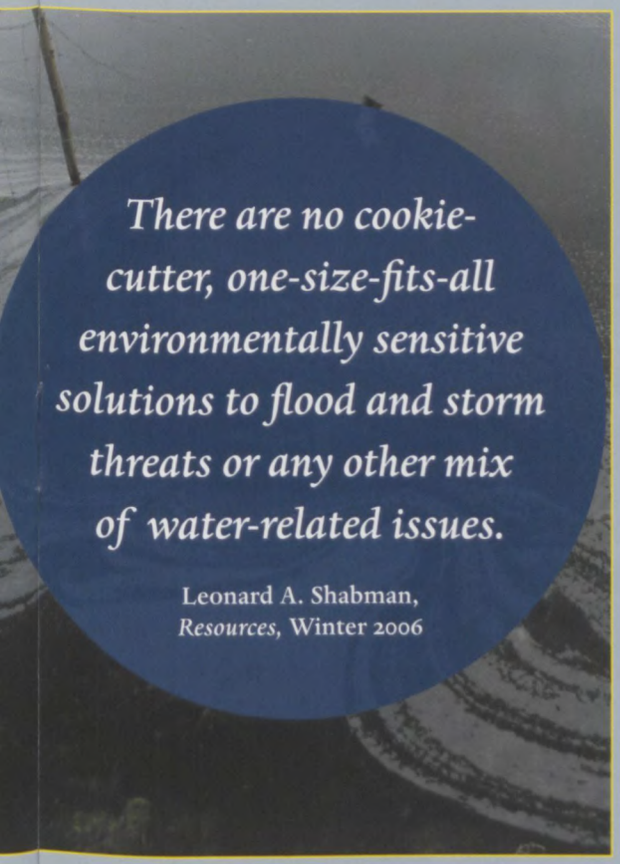


Energy independence has been a rhetorical and political rallying cry for nearly 40 years, and it is as flaccid a concept today as it has been over the decades.

Joel Darmstadter, *RFF Issue Brief* 06-02



There are no cookie-cutter, one-size-fits-all environmentally sensitive solutions to flood and storm threats or any other mix of water-related issues.

Leonard A. Shabman, *Resources*, Winter 2006

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RFF extends its thanks to the corporations and associations that supported our research and outreach efforts in 2006. These dedicated organizations realize that while they may not always agree with RFF's recommendations, they truly value RFF's objective and unbiased voice in environmental and natural resource policy debates. The unrestricted support from our Corporate Associates enables RFF to continue providing its unique brand of research and helps elevate the quality of discussions across the country and around the globe.

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Enforcement has long been the Achilles' heel of international environmental agreements, largely because countries submit to international oversight, which they see as a threat to their sovereignty, only with the greatest reluctance.

Ruth Greenspan Bell,
Foreign Affairs, 2006

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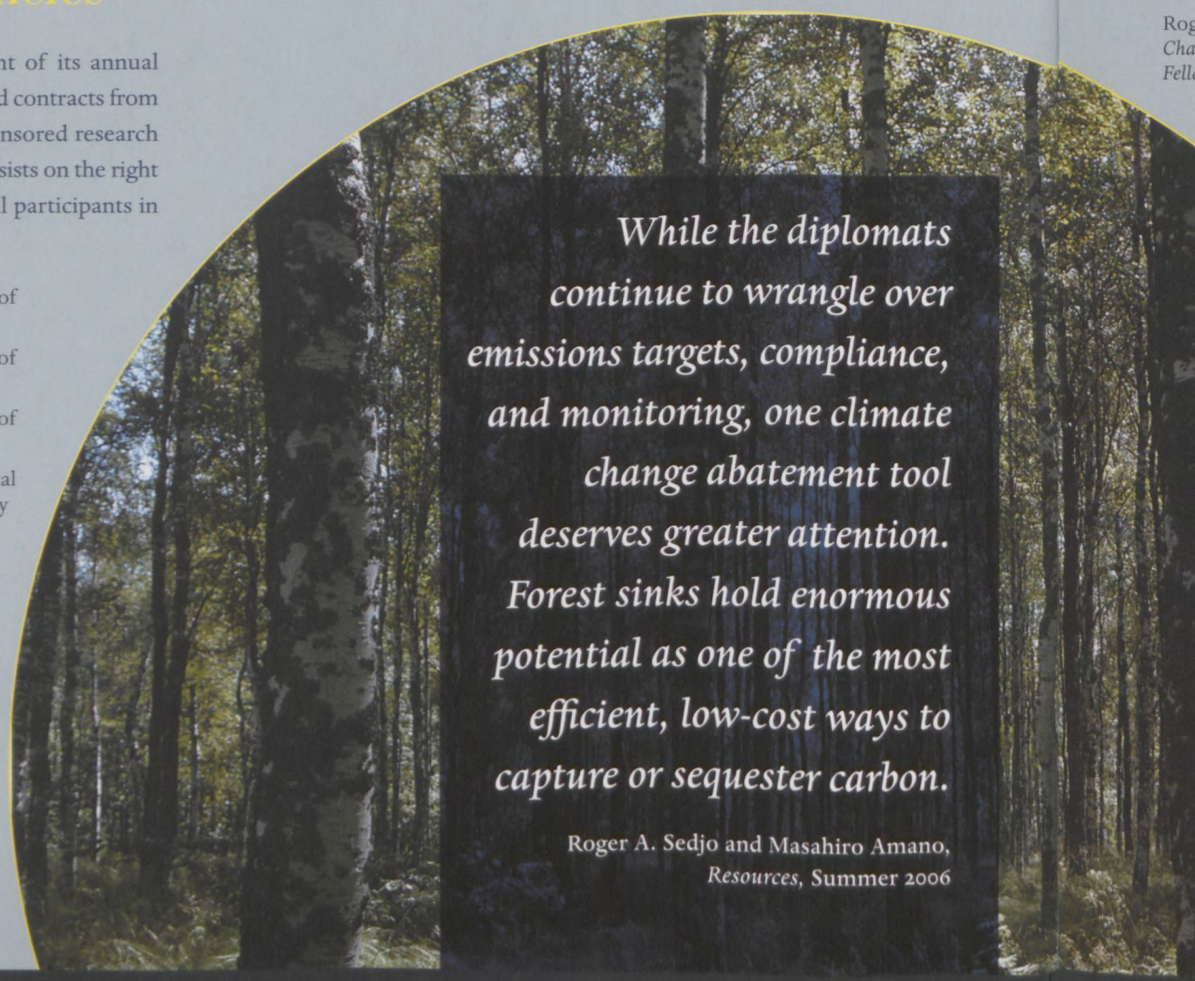

While the diplomats continue to wrangle over emissions targets, compliance, and monitoring, one climate change abatement tool deserves greater attention. Forest sinks hold enormous potential as one of the most efficient, low-cost ways to capture or sequester carbon.

Roger A. Sedjo and Masahiro Amano,
Resources, Summer 2006

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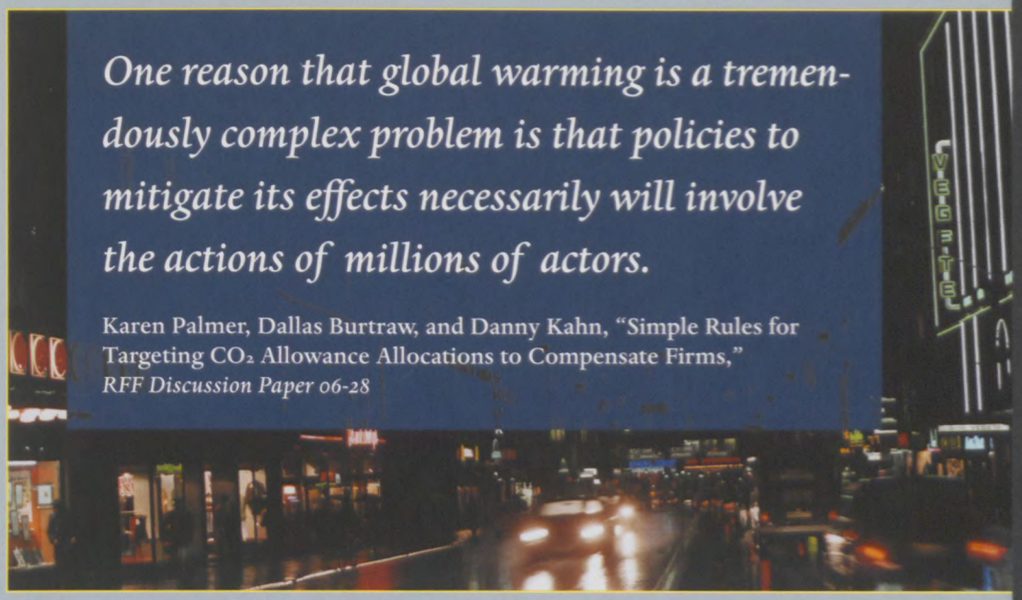

One reason that global warming is a tremendously complex problem is that policies to mitigate its effects necessarily will involve the actions of millions of actors.

Karen Palmer, Dallas Burtraw, and Danny Kahn, "Simple Rules for Targeting CO_2 Allowance Allocations to Compensate Firms,"
RFF Discussion Paper 06-28

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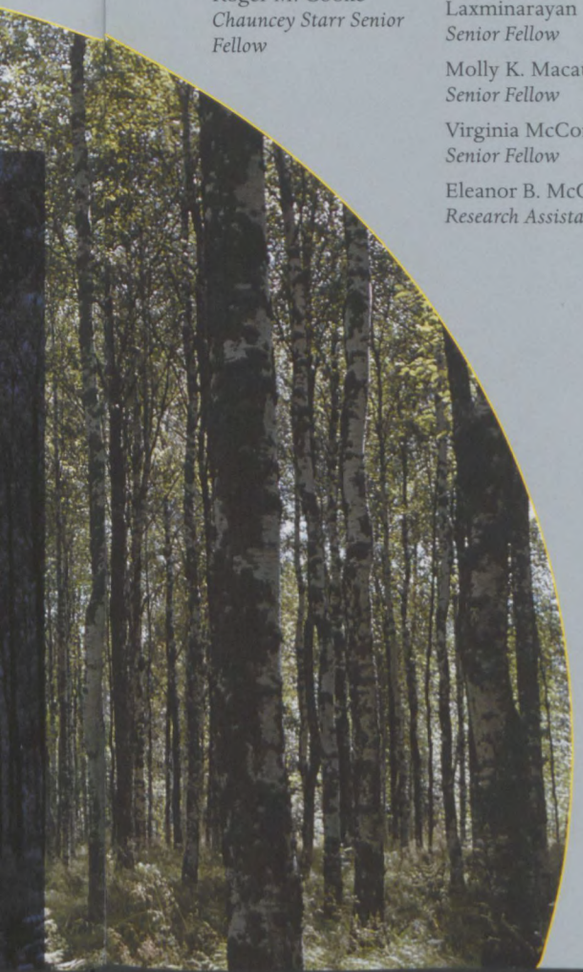

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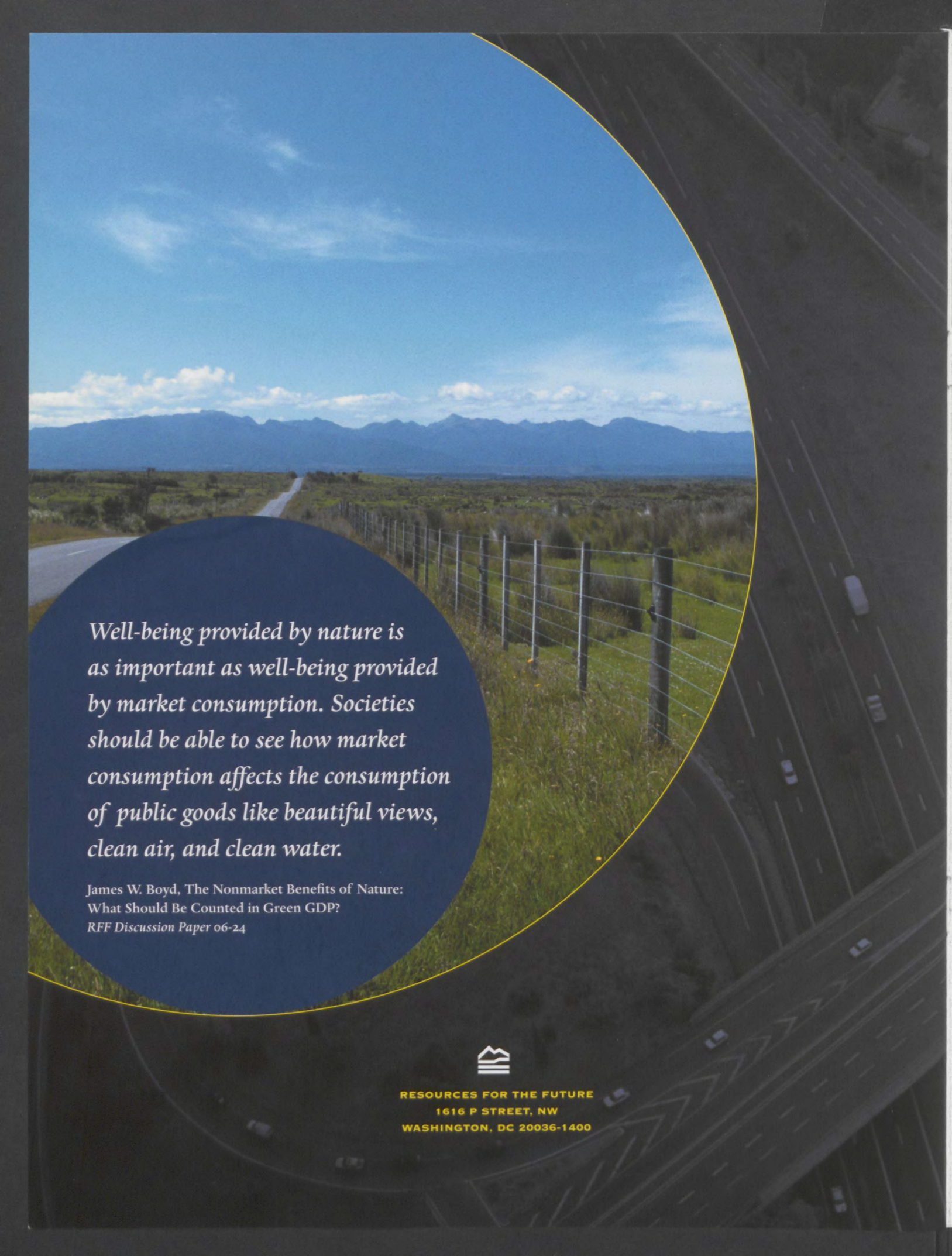

Well-being provided by nature is as important as well-being provided by market consumption. Societies should be able to see how market consumption affects the consumption of public goods like beautiful views, clean air, and clean water.

James W. Boyd, The Nonmarket Benefits of Nature: What Should Be Counted in Green GDP?
RFF Discussion Paper 06-24

RESOURCES FOR THE FUTURE
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WASHINGTON, DC 20036-1400

How Well Do Voluntary Environmental Programs Really Work?

Richard D. Morgenstern and William A. Pizer

The explosive growth in voluntary environmental programs since the early 1990s in the United States, Europe, and Japan reflects, in part, changing societal attitudes about the environment and a growing optimism about the possibility of enhanced cooperation between government and business. It also reflects widespread frustration with the long and expensive battles often associated with new environmental regulations. In most cases, voluntary programs are being used to control pollutants that have not yet been regulated and for which legislative authority may be difficult to obtain. Unlike market-based approaches to environmental management, where the conceptual roots are largely academic, voluntary programs have emerged as a pragmatic response to the need for more flexible ways to protect the environment.

But do these programs actually work as advertised? That is, do they deliver significant environmental gains without the burdens associated with traditional, command-and-control regulation? Quantitatively, how large are the likely gains? And can they really substitute for mandatory requirements, or should expectations be more modest?

Getting credible answers to these questions is important. Friends and foes of voluntary programs are increasingly at odds, sometimes drawing opposite conclusions about the same program. The former, typically on the side of industry, see voluntary programs as a more practical, flexible approach to regulation. The latter, including some environmental advocates, often see them as an obstacle to more stringent, mandatory programs. This polarization may be partly a consequence of poor information.

A Loose Taxonomy

Because the existing literature on voluntary programs primarily focuses on why firms choose to participate, rather than on the final results, we chose to take a different approach, relying on case studies of representative programs (see the box on page 24). The result of this work is a book that we edited, *Reality Check: The Nature and Performance of Environmental Programs in the United States, Europe, and Japan* (RFF Press 2007), which this article is excerpted from (see the RFF Press advertisement on the back cover).

Regulators have come up with numerous terms to describe particular mechanisms: self-regulation, negotiated agreements, environmental covenants, business-led environmental strategies, and others. Nonetheless, a loose taxonomy has evolved, with three reasonably distinct bins, based on how the parameters of the commitment are determined:

Unilateral agreements by industrial firms. Business-led corporate programs fall under this heading, as do commitments or reduction targets chosen by firms or industry associations. Examples of such agreements in the United States include the American Chemistry Council's "Responsible Care" initiative for reducing chemical hazards, and McDonald's replacement of its Styrofoam "clamshell" containers with paper packaging.

Public voluntary programs. Participating firms agree to protocols that have been developed by environmental agencies or other public bodies. Although the public agencies may promote the programs to industry, they do not generally negotiate over the specific terms. Eligibility criteria, rewards, obligations and other elements are established by the public agencies.

Case Study Findings

What follows are brief descriptions of the different programs and highlights of the key findings and observations by the case study authors.

The 33/50 Program

EPA's first voluntary program, 33/50, was established in 1991 amid rising interest in finding a quick, cost-effective, relatively noncontroversial approach to address concerns about toxic releases. Focusing on 17 high-priority chemicals reported to the Toxic Release Inventory, the program emphasized pollution prevention as an environmental management technique. The 33/50 name derives from the program's goal of a 33 percent reduction by 1992 and 50 percent reduction by 1995 below a 1988 baseline.

Although some of the reductions clearly were driven by mandatory provisions of the Montreal Protocol and the 1990 Clean Air Act Amendments, covered releases declined considerably between 1988 and 1995, well in excess of the established goals. Several sophisticated studies have linked participation in the 33/50 program to such declines. However, one recent study, excluding two chemicals regulated by the Montreal Protocol, found negative results—33/50 participation led to higher emissions. While precise conclusions are difficult, this most recent study does raise questions about program performance.

Firms participated in the program for several reasons: they were motivated to cut their toxic releases out of a desire to differentiate themselves from rivals, garner positive publicity, and respond to perceived regulatory threats. Some companies simply welcomed formal recognition for efforts already under way.

Japan's Keidanren Voluntary Action Plan on the Environment

Japan's Keidanren Voluntary Action Plan on the Environment was initiated by industry in 1997, just prior to the negotiation of the Kyoto Protocol. It encompasses large enterprises drawn from 58 business associations, including the industrial, electricity, construction, commercial, and transport sectors. The plan initially was embraced by industry as a means of demonstrating cooperation with the government on greenhouse gas emissions while avoiding mandatory requirements. At present, the nonbinding targets are widely recognized as commitments with which industries are to comply.

Three factors that seem to be motivating industry to comply with the plan are the cooperative relationship between the Keidanren and companies; threats of mandatory policies, such as a tax or cap-and-trade schemes; and awareness of private companies' social responsibility. Some or all of these notions may be particular to the relationship that exists in Japan between the government and business.

In terms of absolute emissions, Keidanren members are committed to stabilizing their collective greenhouse gas emissions at 1990 levels by 2010—a goal for which they are now on track. The key question—confounded by an economic slowdown during the early years of the program—is whether this is significantly different from business as usual.

UK Climate Change Agreements

The United Kingdom was an early and strong supporter of the Kyoto Protocol and has adopted a proactive position on climate change, both domestically and internationally. In 2001, the UK government established voluntary, quantified, climate change agreements (CCAs) with 48 sectoral associations in the industrial, commercial, and public sectors as part of a complex policy mix involving an energy tax, a climate change levy, and an emissions trading system.

When first taking on a CCA, firms could choose either intensity-based or fixed targets (most chose the former) expressed in terms of either energy use or carbon emissions. Overall, CCAs cover about 12,000 individual sites—virtually all those eligible—representing almost 44 percent of total UK industry emissions. Compliance could occur via reductions in energy use or by the purchase of emissions rights in the recently established pilot emissions trading program.

Aggregate emissions during the first two years of implementation were well below the targets, regardless of how they were set. Although a government-sponsored study found widespread compliance, given the low observed credit prices and relatively small number of transactions, CCAs appear only modestly effective in encouraging reductions beyond business as usual.

Denmark's Voluntary Agreements on Energy Efficiency

Beginning in 1996, the Danish Energy Agency established voluntary agreements on energy efficiency as part of a set of revenue-neutral CO_2 and other green taxes imposed on the industrial, trade, and service sectors. Lower rates were applied to energy-intensive firms and those most vulnerable to foreign competition. Virtually 100 percent rebates were given to energy-intensive firms if they entered into a voluntary agreement on energy efficiency with the energy agency. The voluntary agreements thus were considered complements to the tax scheme. If companies failed to follow through with their agreement, there

was an explicit sanction: they had to repay the rebate in full.

Although the voluntary agreements did not involve quantitative targets, rebates were initially conditioned on the completion of verified energy audits and the implementation within three years of all measures estimated to have a payback that exceeded given criteria. Measures to be undertaken included energy-savings projects, special investigations, and energy-management systems. Analyses of the effects of these agreements found reductions of between 2 and 8 percent, with the upper end somewhat suspect because of the small number of firms in that study. In addition, analysts found that most of the savings were realized in early years, leaving less opportunity in the future.

The German Cement Industry

In 1995, the Federation of German Industries, a group of 16 industrial associations representing major sectors of German industry, voluntarily issued the "Declaration of German Industry on Global Warming Prevention" (GGWP), which called for voluntary reductions in fuel consumption of up to 20 percent below 1987 levels by the year 2005. Initial industry commitments did not involve any government-provided incentives nor were they accompanied by threats of future regulation. By 2000, five years in advance of the target date, most of the commitments already were fulfilled, an indication that the targets were not very ambitious.

Subsequently, as the result of pressure by the government and the desire of industry to avoid mandatory requirements, the GGWP goals were made more stringent. For purposes of evaluating the effectiveness of the GGWP declaration, the cement industry was the only one among the 19 industries now in the German Federation for which sufficient historical data were available to compare the CO_2 emissions of the industry following development of the GGWP to emissions in prior years. The authors calculate that the annual fuel efficiency improvements achieved when the voluntary commitment was in effect were about the same as the average over the prior two decades. Thus, they conclude that the industry has not gone much beyond good intention.

Climate Wise

Climate Wise is a voluntary EPA program designed to encourage the reduction of CO_2 and other greenhouse gases in the nonutility industrial sector. Originally established in 1993, it remained in operation until 1999–2000, when it was renamed and placed under the agency's Energy Star umbrella. The requirements were that a participating firm develop baseline emissions estimates, self-designate forward-looking emissions reduction actions, and make periodic progress reports.

EPA provided a checklist of major actions, such as specific boiler modifications and waste-heat recovery systems, and firms were strongly encouraged to select at least some of their proposed actions from this list. EPA also offered several kinds of technical assistance, including a guide to industrial energy efficiency, various government publications on energy efficiency, and free phone consultation with government and private-sector energy experts.

When comparing program participants with equivalent, nonparticipating firms, the principal result is that Climate Wise appears to have had little to no effect on fuel use, while slightly increasing demand for electricity, a seemingly counterintuitive result. There are several possible reasons why this happened. For example, firms may have chosen to increase electricity use to reduce direct CO_2 emissions. In addition, although the focus of the program was on energy efficiency and the reduction of CO_2 emissions, a few firms proposed non-energy reductions, suggesting the fuel focus may be missing part of the story. All of these results become indistinguishable from the absence of any effect after two years, suggesting any program consequence is temporary.

Residential Demand-Side Management Programs in California

Beginning in the 1970s, at the instigation of the regulatory authorities, California electric and gas utilities sponsored programs to promote the residential adoption of energy-efficient technologies and energy-conserving behavioral practices.

At least two of the three programs examined found energy savings on the order of several percent that would not have occurred in their absence. This magnitude is consistent with previous findings of the savings accruing from demand-side management programs such as these that do not include financial incentives.

Savings were reported to be driven principally by changes in the behavior of households—such as improving maintenance of appliances or discontinuing use of secondary refrigerators—rather than by the installation of new equipment. While vaguely aware of the energy benefits of the recommended actions, customers tended not to act on this knowledge until it was suggested by an expert. This implies that a key barrier to action by homeowners may be information from an authoritative source.

Negotiated agreements. These consist of a target and timetable for attaining the agreed-upon environmental objectives and are negotiations between government authorities and a firm or industry group over specific terms. In some cases, participating firms also receive relief from an otherwise burdensome tax, making the voluntary notion of the program somewhat hazy.

It is worth noting that while the delineation into these three categories may seem clear cut, virtually all voluntary programs involve some degree of dialogue between government and firms over various terms.

What Matters After All

Looking across programs, we see effects of between zero and 28 percent—or, focusing on energy-related programs, between zero and 10 percent. The single non-energy/non-climate change program—EPA's 33/50 program, which focuses on toxics—had a dramatically larger effect than the others and suggests that effectiveness is likely influenced by factors related to the kind of pollution being addressed. These factors include the fact that toxics typically are a local or regional problem, while climate change is global; that toxics can have a direct, acute effect on human health; and that with no practical opportunity for end-of-pipe abatement, reductions in energy-related greenhouse gas emissions often amount to reductions in energy use itself—something already incentivized by energy prices.

Among the remaining energy and climate change programs, the context of the program, particularly the additional use of carrots and sticks to encourage and strengthen program effectiveness, appears to have only a limited effect on measurable, quantitative results. It is true that the programs with the weakest incentives, Climate Wise and the German GWP declaration, had the weakest effects. Those with the strongest incentives, the UK and Danish agreements and the Japanese Keidanren program, had the strongest effects. However, the difference is small, with all the energy-related programs having less than a 10 percent effect on emissions, and more typically closer to 5 percent.

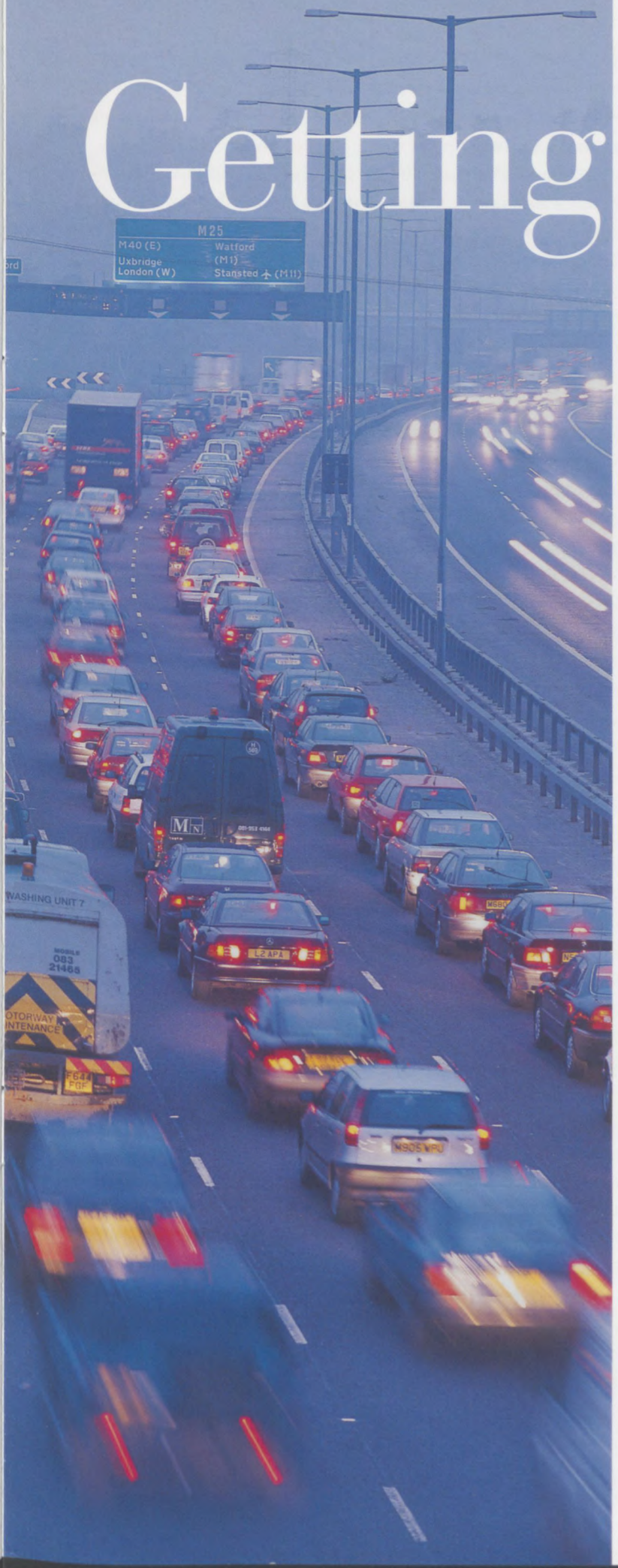
Of course, a 5 percent reduction in energy use or CO_2 emissions is not trivial. Some nations' initial efforts under the Kyoto Protocol amount to roughly that order of magnitude. It also represents potentially billions of dollars in savings. Nonetheless, it represents what appears to be an outer limit on what these kinds of programs can achieve.

In contrast to the limited effect on the magnitude of effects among participants, incentives did play a significant role in the level of participation, with some programs with larger incentives and lower barriers to participation having near universal enrollment. Therefore, despite the lack of a large impact on estimated effects among participants, the fact that the pool of participants is larger means that the overall impact is larger as well.

Advice to Policymakers

Voluntary programs can affect behavior and offer environmental gains but in a limited way. By considering the media and activity, as well as the potential incentives that can be brought to bear, rough assessments can be made of the potential for a voluntary program. A critical step is having a realistic, agreed-upon baseline. In many cases, such programs make sense; when the arguments for mandatory programs are unclear or lacking legal or political support or where such programs will take considerable time to implement, voluntary efforts can play an important role. However, truly convincing evidence of dramatic environmental improvements is lacking. Therefore, we find it hard to argue for voluntary programs where there is a clear desire for major changes in behavior. ■

Getting Off Oil



By Heather L. Ross

ENERGY INDEPENDENCE means getting off oil imports, which means ending most oil use. Yet in the decades since energy independence made its rhetorical debut, both oil use and oil import dependence have risen substantially in the United States. This year has brought new calls for reducing oil dependence, both to enhance national security and to combat global climate change. High on the agenda are government mandates: increased vehicle fuel-efficiency standards, higher targets for alternative fuel use, and a ceiling on greenhouse gas emissions. These steps could reverse oil-demand growth over the next decade, but they will not come close to ending import dependence.

Missing from these proposals is the policy that would most effectively wean society off oil—a tax on oil consumption that increases the price of oil to a level reflecting its true national security and environmental costs. In addition to moving consumers to oil-saving behaviors and goods, particularly fuel-efficient vehicles, the tax would encourage private investment in alternative energy research, development, demonstration, and deployment and could fund public incentives to accelerate such innovation.

While a tax on oil consumption is widely seen as politically unachievable, Congress is already considering legislation to increase oil-sector tax revenues and invest the proceeds in new energy sources. As a further step, an excise tax on U.S. oil

production could provide substantial sums for alternative energy innovation without raising the price of oil to consumers.

In its first 100 hours, the House passed legislation reversing recent oil-industry subsidies and depositing the proceeds in a fund to advance clean domestic renewable fuels. Legislation introduced in the Senate's first week called for eliminating tax giveaways to large energy companies and expanding secure, efficient, and environmentally friendly energy supplies and technology. Like reduced oil subsidies, an added excise tax would be borne principally by oil companies and not passed through to consumers, since imported oil, 60 percent of U.S. supply, would not be directly affected. Also like reduced subsidies, an excise tax at the margin would have minimal effect on domestic oil supply and energy security.

Oil production levies at the margin can affect the life of fields at the edge of profitability, but they have little leverage on investment decisions for new developments because their effect is dominated by the effect of oil-price uncertainty. For example, royalty forgiveness on deepwater federal leases can save oil companies 12.5 percent of production revenues, but this incentive is eclipsed by the impact of oil prices that can halve, or double, over the course of months. Marginal changes in taxes and royalties, applied to large ongoing revenue streams, can lose or gain the government large sums of money without affecting future production very much. A 2005 study for the Interior Department estimated that current deepwater royalty relief provisions would add 1.2 percent to production over the years 2003–2042, at a forgone royalty cost of $23 billion, or $67 per barrel—more than twice the $30 per barrel it would take to buy the barrel outright at the market price assumed in the analysis.

The effect on energy security of any incremental change in domestic production is also small. Producing a little more oil at home will hardly alter the risk of an oil crisis or lessen the shock when a crisis hits. Oil prices will spike to the same high level for domestic barrels as for foreign ones. The cost of a crisis to us will turn principally on how much oil we use, not on how much we produce.

Security is not a matter of finding more oil but finding alternatives to more oil.

At the margin, even funds that find their way into discovering and developing new production will have greater security value if spent on forestalling the need for that production. The benefits of speedier separation from oil and increased 21st-century competitive advantage through a successful portfolio of private and public investments in research and development, demonstration, and deployment of alternative-fuel technologies will dwarf the value of temporarily backing out a slice of foreign oil.

An excise tax that shaved the top off the highest-cost production projects—for example, a tax equal to 35 percent of the market price over $45 per barrel—would concentrate its marginal effects on the outer edge of potential production, where oil-price risk already inhibits investment commitments. Such a tax would raise $10 billion this year at projected levels of production and prices averaging $60 per barrel, money that could finance an Oil Freedom Fund (OFF) for alternative technologies to get us off oil.

There are two cautionary points to make about the tax and the fund. First, the tax would reduce industry profits and trigger familiar arguments against a "windfall profits" tax, notably that the tax would decrease U.S. oil production. While an excise tax would have that effect directionally, as discussed above, any such shift would be small in absolute magnitude and in relative cost compared to the benefit of accelerating new oil-replacing technologies. As world oil prices have moved up in the last few years, many jurisdictions, including the state of Alaska, have introduced tax structures based on price. Second, the fund will need to make investments based on the potential economic and environmental performance of new fuels, not on their current political support. While energy R&D will involve trial and error, sustained subsidies to technologies with no prospect of becoming environmentally and economically sound will defeat both energy independence and trust in government's ability to execute its fundamental security role.

Redirecting resources from the oil sector into seed money for oil replacement is a "second-best" policy, a desirable choice when the optimal policy is not available. Without a tax on oil consumption to convey its true cost to society, private markets are seriously underinvesting in oil-replacing technology. At the same time, vast resources are accruing in oil companies that are selling oil at a much higher price, averaging $66 per barrel last year, than they are using for investment decisions, around $30 per barrel according to published reports. In the big world of oil markets—where ExxonMobil spent $28.6 billion in 2006 to buy back its stock—an excise tax of $10 billion a year would have only a small effect, but it would transform the lean world of oil-saving R&D. A large public-interest advance in energy security and leadership can be pursued for a small shift in the private market that will not deliver either.

Our future well-being as a nation depends on oil reduction, not oil production. Moving from oil exposure to safe, sustainable energy is one of the biggest engines of security, stability, prosperity, and advantage we have in a world of challenges developing around us. Tapping our current oil wealth to advance our future oil freedom is a good way forward. ■

Inside RFF

New Donor Level Established at RFF

by Dod Fraser

As chair of the Development Committee of the RFF Board of Directors, I want to take this opportunity to tell you how our development efforts are responding to meet the growing needs of our robust policy-research institution.

On behalf of everyone at RFF, let me express my gratitude to our donor communities—individual philanthropists, foundations, corporations, NGOs, and government agencies—for their continued support. Their generosity allows us to undertake the much-needed task of illuminating policy discussions in Congress and around the world on energy, environment, and natural resource issues.

DOD FRASER

As a relatively new member of the RFF Council, Rio Tinto continues to discover many ways to benefit from our relationship with RFF. Their scholars have served as expert speakers at internal planning meetings, and we call upon RFF to discuss approaches to policy issues. We also rely on the work of RFF scholars to advance our thinking on issues affecting our business now and in the future.

— PRESTON CHIARO, CHIEF EXECUTIVE OF RIO TINTO ENERGY GROUP

Of our $10.8 million annual budget, 40 percent is derived from investment income from a reserve fund, 25 percent from government grants, 10 percent from individuals and foundations, 10 percent from other institutions, and 15 percent from more than 80 corporate contributors. This diversity means that RFF's research is not beholden to the interests of any one group. Additionally, the vast majority of our investment income—as well as our individual and corporate contributions—is unrestricted. In other words, gifts come with no strings attached, allowing us to undertake important and time-sensitive initiatives, like responding directly to policy debates in the United States and abroad.

RFF currently recognizes those individuals who give $5,000 or more and companies that give $25,000 or more annually as RFF Council members. In addition to receiving complimentary copies of all RFF publications and invitations to events, Council members are encouraged to speak informally with RFF staff, to serve on program advisory committees, and to participate in small, off-the-record dialogues on global climate change, electric utility restructuring, sustainable forestry, air quality, environmental risk assessment, among many other issues.

I am pleased to announce that at the October meeting of the RFF Board, our Directors approved the formation of a new donor recognition level for corporations—the President's Circle. The President's Circle recognizes those corporations that provide annual financial support of $50,000 or more.

In addition to the benefits extended to RFF Council members, President's Circle members will be able to access our researchers for two days each year, either at RFF or another location, to brief company executives on RFF research and analysis, as well as to discuss policy developments.

RFF's relationships with the corporate community enable our researchers to gain important insights into how businesses are affected by regulation and engage in the policy process, and they help "ground truth" our analysis. Combined with parallel dialogues with the NGO and government communities, these discussions ensure that all viewpoints and experiences are better understood.

As RFF continues to strive to be a relevant, trusted voice in the policy process, we are constantly evaluating our relationships with and the value that we provide to our donors. We are grateful for all those who understand the importance of sound research in the policymaking process and look forward to more successful partnerships in the future. ■

The Weyerhaeuser Company Foundation began supporting RFF in 1976 in recognition of the need for an independent organization to examine the role of forestry in U.S. environmental policy. RFF provides valuable research to policymakers, our colleagues in the environmental community, and our peer forest products companies on issues critical to our future.

We trust RFF's analysis and recommendations because they are nonpartisan and based on rigorous research. We are delighted to participate this year as a member of the new President's Circle and look forward to working with RFF on the tough policy issues affecting our industry and country.

— CASSIE PHILLIPS, VICE PRESIDENT OF SUSTAINABLE FORESTRY, WEYERHAEUSER COMPANY

Consumer, Competitor, or Collaborator? Assessing China's Economic, Energy, and Resource Environment

In recent decades, China's burgeoning growth has pulled hundreds of millions of its citizens out of poverty and placed the nation among the world's economic powerhouses. At the same time, the country has witnessed wrenching social changes and environmental challenges.

To assess the state of Chinese progress—and analyze its impact on the global economy—the fall 2006 RFF Council meeting was devoted to a wide-ranging examination of economic, energy, and environmental trends in the world's largest nation.

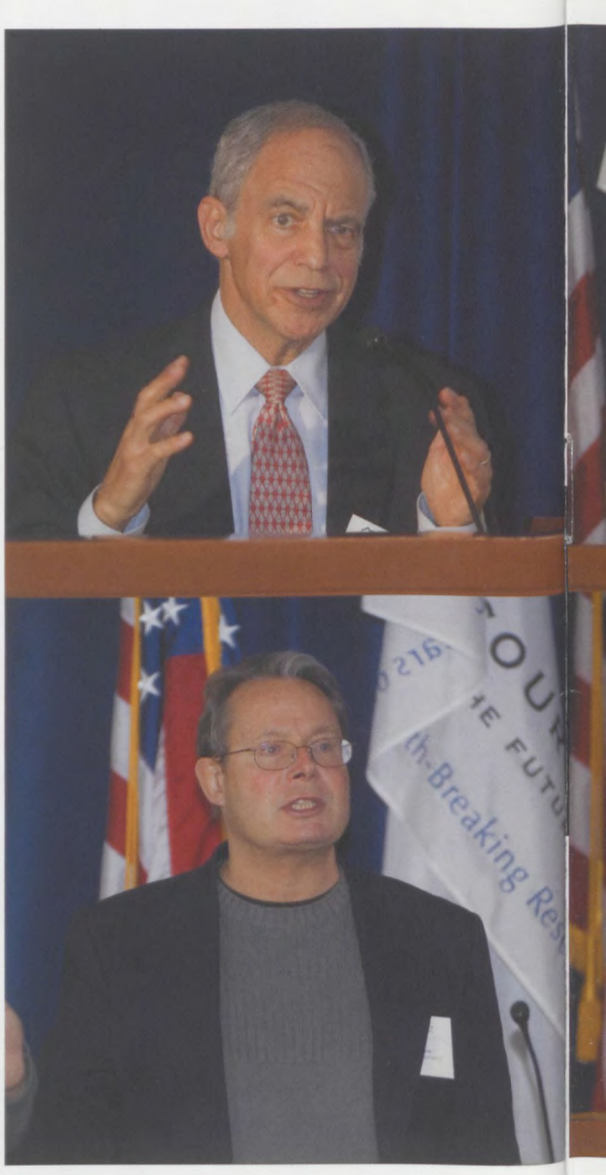
At the outset, President Phil Sharp noted RFF's longstanding involvement with Chinese research efforts, including the establishment of the Walter Spofford Internships for China scholars and assistance with the founding of the Beijing Environment and Development Institute in the late 1990s.

In his opening remarks, Nicholas Lardy of the Institute for International Economics asserted that the Chinese economy is not as healthy as headlines might suggest. Much of its growth has been fueled by outside investment and high export volume, while household consumption in China is the lowest, as a share of gross domestic product (GDP), in the world.

"China currently consumes only about 40 percent of what it makes," Lardy said. "While the Chinese government has announced a laudable intent to move toward consumption-led growth, that transition is off to a slow start." While revenues from exports will remain important drivers of the Chinese economy, Lardy said, there is a growing demand for government investment on health, education, welfare, and pensions by Chinese workers.

Kenneth Lieberthal, distinguished fellow and director for China at University of Michigan's William Davidson Institute, framed a discussion about China's political system and environmental problems within the context of China's spectacular growth, resource scarcity, and emerging environmental sensitivities.

As evidence of the growing importance of the environment to the Chinese, Lieberthal noted that out of 87,000 protests in China in last year, nearly 10 percent were environmentally driven. In addition, the Chinese government has dedicated $175 billion to environmental projects. However, such momentum is dampened by a political system that favors GDP growth over the environment, he said. Because political leaders at local, state, and national levels are tasked with growing GDP at aggressive levels—and because performance reviews largely focus on GDP growth rather than environmental and other concerns—China's political economy results in a "growth machine" made up of "bureaucratic capitalists," Lieberthal said.



Featured speakers at RFF's fall Council meeting included (clockwise from top left), Kenneth Lieberthal, Nicholas Lardy, Ruth Greenspan Bell, and Peter Kareiva.

He also suggested that although China excels at building clean facilities, it is less skilled at using them. "The hardware is there, but software and respect for the law are not," he said. To turn this situation around, Lieberthal noted, the incentive structure for leadership needs to change; however there is currently no indication of impending changes to the current political economy.

Another China expert, James P. Dorian, a government energy consultant

and longtime senior researcher at the East-West Center in Hawaii, warned the audience about China's emerging energy demands—and the possible environmental consequences. "Energy usage in China will double by 2020," he said, noting that China currently builds a new power station every 10 days.

"But by 2010, China will overtake the United States as the world's largest polluter," Dorian said. "Sixteen of the world's 20 most-polluted cities are in China, a condition that claims 300,000 lives a year." Moreover, he noted that China has an estimated 70 million households still without electricity, households that someday will draw power from coal-fired plants—a fact that must be integrated into the nation's plans to contain greenhouse gas emissions.

No other country in the world will have as great an impact on the world's energy industry than China, Dorian said, across the spectrum of available energy resources—coal, oil, gas, nuclear, and renewables. Given the importance of coal to China's long-term economic future and environment, and the ongoing transportation bottlenecks, plus the possibility of dramatically increased use of passenger cars over the long term, it is arguable that these two particular sectors of the Chinese economy need more focus and analysis, Dorian said.

The two-day meeting concluded with panel discussions focused on a range of environmental challenges, including air pollution trends, willingness to pay for health-related programs, transportation issues, and water policy. In addition to comments from RFF researchers Ruth Greenspan Bell, Alan Krupnick, and Richard Morgenstern, the program included remarks from Jostein Nygard, a senior environmental specialist with the World Bank; Lee Schipper, a senior researcher at World Resources Institute's Center for Sustainable Transport; and Peter Kareiva, a lead scientist with the Nature Conservancy. ■

RFF Board Elects Charles F. Kalmbach

There's no other organization like it," says Charles F. Kalmbach of RFF. A specialist in organizational management and strategic change, Kalmbach recently joined the RFF Board of Directors for a three-year term.

He lauds RFF for its focus on the environment and for its nonpartisan, rigorous, fact-based economic analysis, and believes that RFF can have a positive impact on environmental policymaking around the world. "I am enthusiastic about working with RFF staff and administration and feel privileged to have the opportunity to contribute," Kalmbach says.

Kalmbach is currently vice chairman of the board of trustees of the University Medical Center of Princeton. From 2004 until 2006, he was president and chief executive officer of DBM, Inc., a Philadelphia-based human capital management and transitions firm with 230 offices serving 85 countries. He restructured the company's global operations and expanded its services in India and China.

An undergraduate and graduate alumnus of Princeton's School of Engineering and Applied Science, Kalmbach returned to his alma mater in 2002 to become the university's senior vice president for administration. In that position, he handled the management and organization of administrative affairs, establishing new planning

processes and revamping the project management process to accelerate an expanded building program.

In previous positions in senior management at Accenture, PriceWaterhouse, and McKinsey & Company, Kalmbach worked with clients on developing strategies for achieving sustainable growth and maximizing organization and workforce performance.

Kalmbach has had a lifelong interest in scouting, outdoor sports, and the world around him. "In three decades of traveling around the globe," he says, "I have seen how little care we give the environment. We Americans once had no qualms about emitting pollutants from burning coal, so it's hard to turn to developing countries and ask them not to, but we've got to deal with it. Smokestacks in China are directly affecting the rest of the world. Not only is the world flat, as Thomas Friedman tells us, but the environment knows no borders."

Kalmbach holds B.S.E., M.A., and Ph.D. degrees from Princeton University in applied mathematics and mechanics. He also has a J.D. degree from the University of Pennsylvania in corporate and international law. The author of 25 published articles on engineering, legal, and business topics, Kalmbach wrote *The Paradox Principles: How High Performance Companies Manage Chaos, Complexity and Contradiction to Achieve Superior Results* and was a contributing author to *Better Change: Best Practices for Transforming Your Organization,* both published by Irwin. ■

CHARLES F. KALMBACH

Linda J. Fisher Joins RFF Board

Linda J. Fisher, elected in October to RFF's Board of Directors, brings more than 25 years of experience in government and the private sector working on environmental issues and improving the protection of public health in the United States.

LINDA J. FISHER

Fisher is currently vice president and chief sustainability officer at DuPont, where she is responsible for advancing the company's progress in achieving sustainable growth and heads its environmental and health programs, product stewardship programs, and global regulatory affairs. She joined DuPont in June 2004.

Previously, she served in a number of key leadership positions in government and industry. Notably, she worked from 1983 to 1993 and again from 2001 to 2003 at EPA, where she held more high-ranking positions than any other person in the agency's history. These include deputy administrator; assistant administrator for the Office of Prevention, Pesticides and Toxic Substances and the Office of Policy, Planning and Evaluation; and chief of staff to EPA administrator Lee Thomas.

During her tenure at EPA, she was responsible for working with Congress to ensure the continuation of a reformed and improved Superfund program for cleaning up toxic wastes and strengthening national food safety laws. She also played an instrumental role in developing the agency's first reports on climate change. She became familiar with RFF during her first stint at EPA and cites Kate Probst's report, *Superfund's Future: What Will It Cost?,* which fed an important dialogue group on the issue, as one example of RFF's "real contribution of high-quality work."

Fisher grew up in Columbus, Ohio, and received a B.A. from Miami University, an M.B.A. from George Washington University, and a law degree from Ohio State University.

Achieving sustainability, she says, "is going to require societies and business to think differently about how it uses its non-renewable resources." She notes that RFF has brought much to bear on this issue by introducing economics into energy and environmental policy.

"This is important, because as we look to current environmental problems, we need cost-effective solutions, or they won't be sustainable," she says. ■

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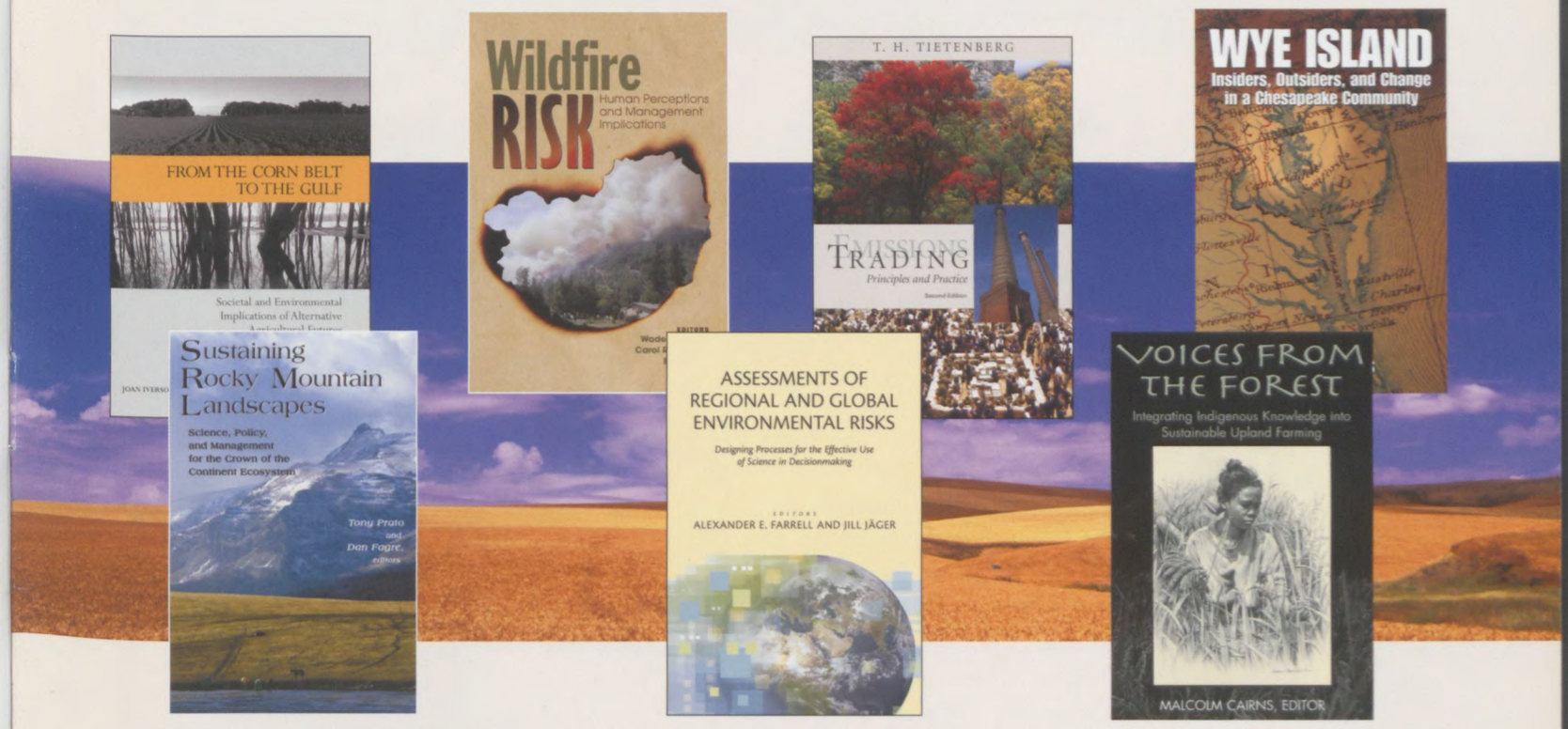

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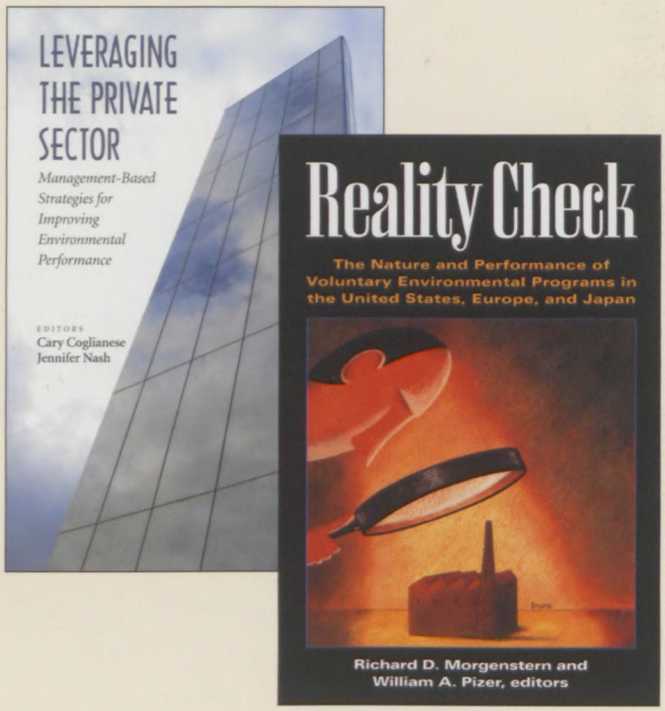

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