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RESOURCES



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In This Issue

Dallas Burtraw is the Darius Gaskins Senior Fellow at RFF and one of the nation's foremost experts on environmental regulation in the electricity sector. For two decades, he has worked on creating a more efficient and politically rational method for controlling air pollution. His current areas of research include analysis of the distributional and regional consequences of various approaches to national climate policy.



Burtraw

RFF Fellow **Rebecca Epanchin-Niell**'s research focuses on ecosystem management, particularly understanding how human behavior affects ecological resources and identifying strategies to improve management. Much of her work has focused on invasive species, including strategies to control established invaders, improvement of monitoring strategies, and cooperative management.



Epanchin-Niell

Carolyn Kousky is a fellow at RFF. Her research focuses on natural resource management, decisionmaking under uncertainty, and responses to natural disaster risk. She has examined how individuals learn about extreme-event risk, the demand for natural disaster insurance, and policy responses to potential changes in extreme events with climate change.



Kousky

Joshua Linn is a fellow at RFF. His research centers on the effect of environmental regulation and market incentives on technology, with particular focus on the electricity sector and markets for new vehicles. His studies on new vehicle markets investigate the effect of CAFE standards on new vehicle characteristics and the effect of gasoline prices on new vehicle fuel economy.



Linn

RFF Senior Fellow **Virginia McConnell** works on environmental issues related to air pollution and urban transportation. Her recent focus has been on evaluating policies to reduce vehicle pollution, programs to scrap old cars, inspection and maintenance programs, and emissions taxes.



McConnell

Matthew McKinney is director of the Center for Natural Resources and Environmental Policy at the University of Montana, where his work focuses on collaborative approaches to natural resource and environmental policy. He has designed, facilitated, and mediated more than 50 public processes on issues related to federal land, water, fish and wildlife, land use, and other public issues.



Morris

Daniel F. Morris is a center fellow in RFF's Center for Climate and Electricity Policy. His research focuses on the policy and economic implications of a broad swath of climate change issues. Previous research topics include the dynamics of multiple forms of carbon pricing, US federal policy for adaptation, international climate negotiations, and the role of water supply in energy production.



Munnings

Clayton Munnings is a research assistant at RFF, where he primarily focuses on carbon pricing. His research topics include the design of carbon pricing programs, linkage of cap-and-trade systems, and the economics of carbon offsets. Before joining RFF, he worked as a policy adviser at the International Emissions Trading Association.



Scarlett

RFF Visiting Scholar **Lynn Scarlett** is co-director of RFF's Center for the Management of Ecological Wealth. She has extensive experience in government and academia on issues related to effective stewardship of land, water, and wildlife resources. From 2005 to 2009, she was deputy secretary and chief operating officer of the US Department of the Interior.



Sedjo

Roger Sedjo is a senior fellow at RFF and director of RFF's Forest Economics and Policy Program. His research interests include forests and global environmental problems, climate change and biodiversity, public lands issues, long-term sustainability of forests, industrial forestry and demand, timber supply modeling, and forest biotechnology.



Walls

Margaret A. Walls is a research director and senior fellow at RFF. Her current research focuses on issues related to urban land use, ecosystem services, parks, and energy efficiency. She has analyzed transferable development rights programs for managing land use in urban fringe areas, assessed the value of different types of parks and open space, and investigated energy-efficiency issues in buildings.



Zetterberg

Lars Zetterberg is a senior scientist and director of business development at IVL Swedish Environmental Research Institute. His research focuses on design and economic analyses of emissions-trading systems, pathways to low-carbon economies, and the role of bioenergy in climate mitigation.

Embracing Collaboration to Improve Environmental and Natural Resource Policy



The environmental and natural resource challenges we face are complex and multidimensional. By their nature, they require collaborative solutions.

To take just one example, the article by Lynn Scarlett, Rebecca Epanchin-Niell, and Matthew McKinney in this issue highlights the ways in which fulfilling the mission of the US Endangered Species Act is prompting cooperation across disciplines, jurisdictions, institutions, and the public and private sectors.

The collaborative nature of today's environmental initiatives has implications for our work at RFF, where partnerships are increasingly becoming standard practice. Leonard Shabman's work with the World Wildlife Fund and others to help implement a payment-for-ecosystem-services program in Florida—also featured in this issue—gives a flavor of what's involved in RFF's shared efforts.

We also have long-standing partners—such as the international Environment for Development network, which brings together scholars from around the world to produce vital economic research that supports both economic growth and environmental quality. Similarly, we partnered with the University of Maryland to establish the National Socio-Environmental Synthesis Center, known as SESYNC, a cutting-edge center that is a home for collaborative research on such critical issues as water availability, sustainable food production, and the interaction between human activity and healthy ecosystems.

And just recently, we've received word of funding for several new major collaborations that will address important natural resource and risk-related issues, including aging infrastructure, changing demographics, extreme weather events, and biodiversity protection. These initiatives are strongly interdisciplinary, bringing together the fields of engineering, economics, risk assessment, public health, and hydrology, among others. RFF's many first-class partners include Johns Hopkins University, the University of South Florida, and Yale University.

Many of these new efforts fall within RFF's Center for the Management of Ecological Wealth. In one new partnership, RFF researchers will collaborate with partners to reimagine aging coastal infrastructure in urban areas to maximize nutrient recovery and management. In another, a team will examine how certain regions can build resilience to the impacts of repeated hurricanes and heat waves. Other researchers have received funding to help Latin American and Caribbean countries make more effective investments in biodiversity conservation.

We are excited about enhancing RFF's existing partnerships and building new collaborations. Not only do they serve as a tremendous experience and inspiration for our researchers, they also offer the opportunity for RFF to introduce its unique brand of policy research expertise to new and important circles.

A handwritten signature in blue ink that reads "Phil Sharp". The signature is fluid and cursive, with a long, sweeping underline.

Phil Sharp, President
sharp@rff.org

CAFE: Past, Current, and Proposed New Standards

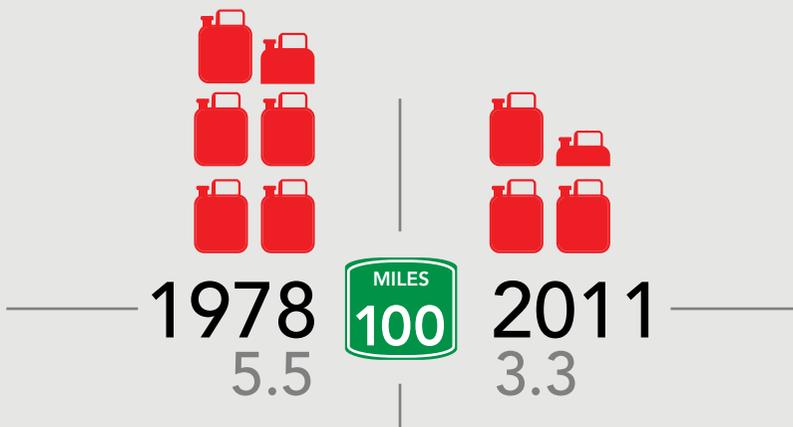
The first Corporate Average Fuel Economy (CAFE) standards on automakers were implemented in the late 1970s. Typically they are expressed in miles per gallon, or mpg. However, in order to show how the standards affect fuel consumption, many economists explain CAFE standards in terms of gallons used per 100 miles, as shown here. They have been changed several times, resulting in a significant decrease in the number of gallons used per 100 miles—from 5.5 gallons in 1978 to 3.3 gallons in 2011 for cars (Figure 1).

Recently, even stricter standards have been established, this time under two new regulations. The first sets minimum limits

for 2012 to 2014 model year cars and light trucks and the second for 2017 to 2025 model years. For the first time, both fuel economy and the associated greenhouse gas emissions from vehicles will be regulated by the standards, which have been jointly established by the National Highway Traffic Safety Administration (NHTSA) and the Environmental Protection Agency.

Figure 2 captures the predicted effects of the new revised CAFE standards for cars on the two goals of reducing fuel consumption (gallons used per 100 miles) and greenhouse gas emissions (grams per mile). Similar standards exist for trucks. The greenhouse gas emissions from the

Figure 1. Gallons Used per 100 Miles by Cars
The impact of fuel efficiency standards (1978 and 2011)

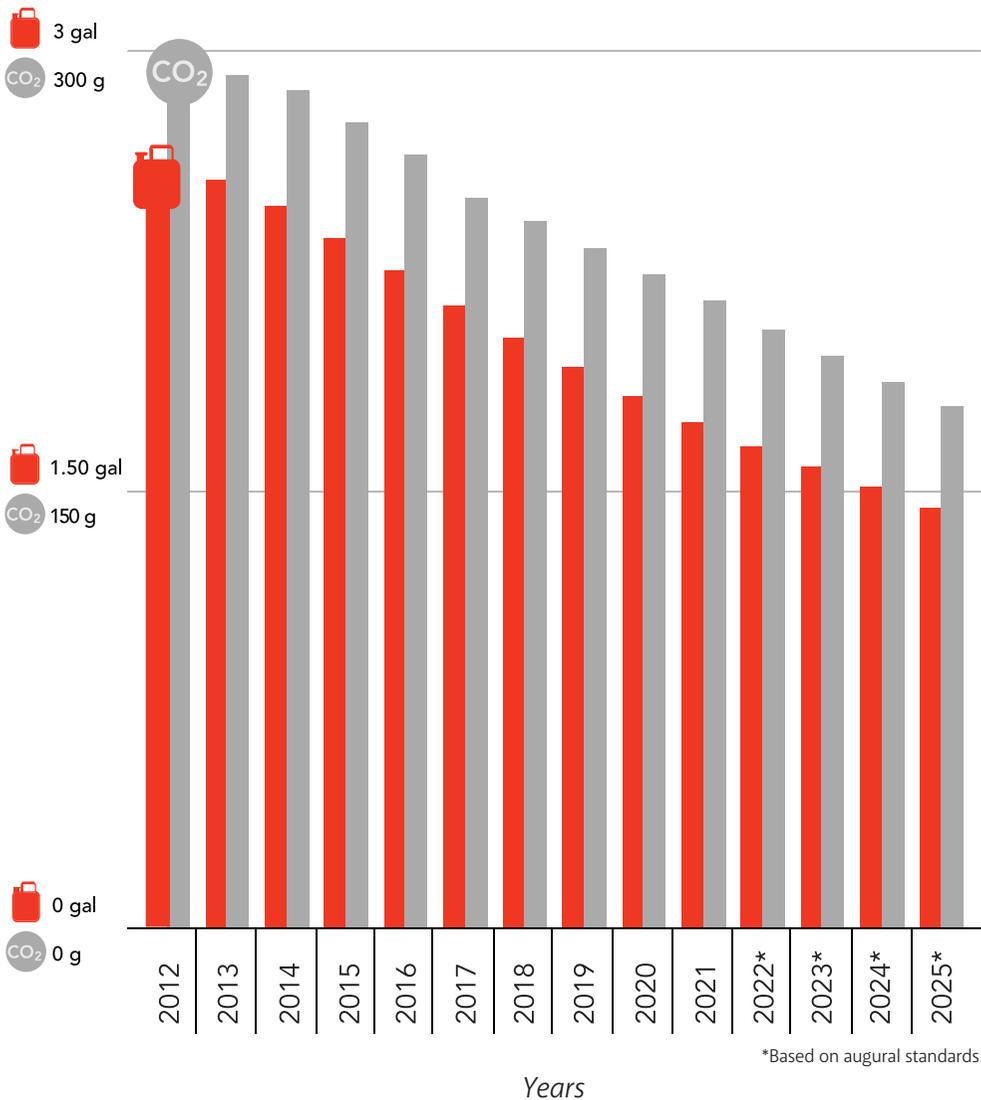


new vehicle fleet are expected to fall by close to 40 percent by the 2025 model year compared with current levels.

The standards after 2011 are based on a vehicle's footprint (the area between the vehicle's four wheels on the ground),

so each manufacturer faces a separate standard. Previously they were based on a single average standard for all vehicles. The reductions in fuel use and emissions are based on NHTSA predictions of car sales and technology adoption.

Figure 2. Predicted Effects of the New CAFE Standards for Cars
Gallons used per 100 miles and grams of CO₂ emitted per mile



Source: McConnell, Virginia D. 2013. *The New CAFE Standards: Are They Enough on Their Own?* Discussion paper 13-14. Washington, DC: Resources for the Future.

Highlights of RFF's Recent Contributions to Shaping Environmental Policy

A North American Approach to Climate Change

In this RFF Policy Leadership Forum on May 22, Yves-François Blanchet, Minister of Sustainable Development, Environment, Wildlife, and Parks of Quebec, discussed how Quebec and California are progressively linking their carbon markets.

▶ www.rff.org/quebec



CONVENING THOUGHT LEADERS

Tax Reform and Climate Policy

February 27

RFF's Center for Climate and Electricity Policy and the Fiscal Affairs Department of the International Monetary Fund convened a panel of leading economic experts in fiscal and environmental policy to discuss the role a carbon tax might play in coming debates about how to reform the US tax code.

▶ www.rff.org/taxcode

Environmental Leaders

March 27

RFF partnered with the Stanford Woods Institute for the Environment to host a workshop at DC Boot Camp 2013, part of the Stanford Woods Rising Environmental Leaders Program. RFF's Vice President for Research and Senior Fellow Molly Macauley and Pete Nelson, RFF's director of communications, moderated sessions on the role of think tanks in policymaking and researcher collaborations with nongovernmental organizations.

Limits of Ingenuity

May 6

This special event, moderated by RFF Senior Fellow and Co-Director of RFF's Center for the Management of Ecological Wealth James Boyd and co-hosted with the National Socio-Environmental Synthesis Center, tackled two questions: Can we "substitute" our way out of ecological problems and losses? And are there limits to ingenuity? A panel of historians, ecologists, economists, psychologists, and entrepreneurs attempted to answer those questions.

▶ www.rff.org/ingenuity

Ice Sheets on the Move

June 12

RFF's June First Wednesday Seminar explored the impact of melting ice sheets and rising sea levels. Panelists discussed the state of climate science, methods for quantifying uncertainty, and the potential consequences of abrupt sea-level rise.

▶ www.rff.org/icesheets

The Impacts of a Carbon Tax

June 26

RFF researchers revealed results from a new model of the US economy that analyzes the economic, distributional, and environmental impacts of a federal carbon tax for current and future generations.

 www.rff.org/carbontaximpacts

Understanding the Risks of Shale Gas

June 27

Researchers in RFF's Center for Energy Economics and Policy presented the results of their multifaceted, multiyear research initiative to survey experts and the public to identify priority risks of shale gas development and assess regulatory frameworks at the state level.

 www.rff.org/shalegasfindings

ENGAGING WITH POLICYMAKERS

Energy Efficiency

March 11

In a briefing at the US Capitol Visitors Center hosted by the Alliance to Save Energy and United Technologies, RFF Research Director and Senior Fellow Karen Palmer discussed the opportunities for and challenges of promoting energy efficiency in buildings.

Climate Policy in California

May 16

RFF Darius Gaskins Senior Fellow Dallas Burtraw testified before the California State Senate Select Committee on Climate Change and AB 32 Implementation on California's leadership in climate policy.

 www.rff.org/ab32

BUILDING PARTNERSHIPS

National Parks

March 19

RFF Visiting Scholar and Co-Director of RFF's Center for the Management of Ecological Wealth Lynn Scarlett explored how to build

sustainable funding models for US national parks at an event hosted by the Bipartisan Policy Center.

 <http://bipartisanpolicy.org/events/2013/03/building-more-sustainable-future-americas-national-parks>

Living Sustainably

April 15

In a live video chat for the *Wall Street Journal's* segment "The Experts: Energy," RFF Research Director and Senior Fellow Margaret Walls—along with actor Ed Begley, Jr., and the Alliance to Save Energy's Kateri Callahan—discussed the challenges of "living green."

 http://stream.wsj.com/story/experts-energy/SS-2-135538/SS-2-208457/?mod=wsj_streaming_experts-energy

Climate Adaptation

April 29

At the Milken Institute, RFF Vice President for Research and Senior Fellow Molly Macaulley, along with representatives from the Environmental Defense Fund, the Council on Foreign Relations, and others, discussed how to manage the risks from global warming.

 www.youtube.com/watch?v=wYS1AoZc53g

Environmental Regulations and the Economy

May 13

RFF University Fellow William Pizer and Senior Fellow Richard Morgenstern presented at the 38th Annual American Association for the Advancement of Science Forum on Science and Technology Policy on how environmental regulations affect the economy and jobs.

 Video  Article or paper

Leading on Climate Policy: The Experiences of California and Sweden

In the first week of May 2013, the concentration of carbon dioxide in Earth's atmosphere broke through the 400-parts-per-million level. This milestone pushes the stated goal of the international community to keep worldwide temperatures below a 2°C increase even farther from reach and illustrates the relentless challenge of climate change. A comprehensive international

agreement to rein in emissions of greenhouse gases has proved elusive, and the world's largest emitters have had decidedly mixed progress in terms of crafting effective national climate policies. At the same time, there are notable examples both at the national and subnational levels of pioneering climate policy initiatives.

In the context of global climate change, Sweden and California share a leading role in the development of policy within their jurisdictions and outreach to their communities. But they do not want to stand alone.

its leadership within Europe with respect to water pollution and acidification in the environment. California is recognized within the United States for its leadership with respect to air pollution.

In the context of global climate change, the two share a leading role in the development of policy within their jurisdictions and outreach to their communities. But as lead-

ers, they do not want to stand alone, and they seek collaboration. These jurisdictions, in acting as leaders, have strong connections to their counterparts abroad. Three themes emerged in the workshop:

- » Multiple approaches and policy instruments played essential roles in the environmental successes of California and Sweden.
- » The crucial interaction between air pollution and climate change requires coordinated action.
- » Strong research and development undergirds the two leaders' success in designing and implementing climate policy.

Against this backdrop, a delegation of 12 academics and regulators from Sweden joined nearly 100 counterparts in San Francisco this spring for the workshop "What Is the Value of Being First? Perspectives from the California and Sweden Experiences," co-hosted by Resources for the Future, the Swedish Mistra Indigo program, and the ClimateWorks Foundation. Within their respective communities, the country of Sweden and the state of California are recognized as leaders in environmental policy. Sweden is recognized especially for

California and Sweden: The Path to Leadership

California possesses a different perspective on climate than other states and nations, in part because of its unique nexus of problems and opportunities for regulation



related to transportation. The geographic size of the state and the corresponding automobile market, in combination with its photochemical smog and the associated damage to crops and human health, spurred California's leadership on air pollution before action was taken in Washington. That leadership position led to a special provision that essentially allows the state to write rules that meet or exceed those written under the Clean Air Act. In turn, other states have the option to adopt California's rules in lieu of federal rules when they are more stringent.

Another factor that has contributed to the state's success is the skilled technical staff at the California Environmental Protection Agency's Air Resources Board. Still another factor is strong legislative leadership, including bipartisan gubernatorial support.

Finally, research and development is essential. California's environmental policy—just like the state overall—has benefited from the presence in the state of 7 of the top 50 research universities in the world.

Sweden is a first mover on climate policy because it had the opportunity to act, and

its policies have been driven by hard science. The country's neutrality during World War II has proved to be one advantage that allowed it to think about environmental issues before most countries.

Additionally, there have not been large political fights about environmental issues in Sweden. Politicians and the public at large generally have agreed that they want a clean environment.

The same opportunities have not always been the case with respect to climate policy, however. Sweden has moved forward in pursuing a clean energy portfolio despite the challenges of needing energy imports and possessing limited energy resources within the country's borders.

Sweden is more hesitant to be a first mover today than it was in the past, in part because of its open borders within the European Union. The country worries that if it continues to be first on climate policy and if this raises the cost of production in Sweden, it may not be able to compete with the rest of the European Union. Despite those concerns, Sweden has increased its GDP by 50 percent with no increase in GHG emis-

sions since 1990—so there can be success as a front-runner.

Multiple Approaches and Policy Instruments

Successful environmental improvements have required persistent regulatory efforts, but policymakers have employed flexible regulations infused with incentives when possible, including the use of prices to improve efficiency and reduce costs. Regulation has thus far played a larger role than environmental pricing (such as a cap-and-trade program or emissions taxes) and continues to do so in California. Workshop participants noted a concern about the use of environmental prices, in that they may exacerbate emissions leakage and undermine competitiveness when there is incomplete participation among major economies. Combining regulatory policies with pricing allows prices to be set at a relatively lower level, which may help preserve competitiveness.

The data presented at the event suggest only weak evidence that environmental prices have driven innovation or technology diffusion. Nonetheless, higher fuel taxes in Sweden and elsewhere around the globe are associated with greater fuel efficiency. Evidence also suggests that economies continue to grow after environmental prices are introduced.

Experience with regulation, which has been more common, shows abundant evidence of innovation. Engineers and other innovators respond when they are given incentives to do so. Local governments also respond to incentives in planning infrastructure. The historic experience invites a mix of policies looking forward. But even where regulation plays a dominant role, there is the hope that the greater use of prices over time can introduce more efficiency and reduce costs.

Linking Air Pollution and Climate Policy

At the global level, climate pollution that has a short residence time in the atmosphere, including black carbon from the combustion of coal and biomass, is recognized as the second most important source of climate pollution behind carbon dioxide emissions. Short-lived pollution is especially damaging in the Arctic region, where it contributes to the melting of snowpack and local warming. Such pollutants have been a traditional focus of conventional air pollution policy; black carbon, for example, also leads to substantial negative health outcomes, especially in the developing world.

In California, reducing conventional air pollution to achieve associated health outcomes may be harder than meeting greenhouse gas emissions targets, and doing so will require coordinated regulations. Workshop participants also noted that, going forward, nitrogen oxides may become the binding constraint for both air pollution and climate change, with growing relevance also in water pollution.

The Role of Research and Development

Success in both Sweden and California has been built on research and development. This element of success includes natural science, technology, and social science research. In both jurisdictions, the orientation toward research and development to investigate problems and find solutions as well as the reliance on science as a basis for regulation have contributed to the success of industry and a culture of innovation. ●

—DALLAS BURTRAW, DANIEL F. MORRIS, AND LARS ZETTERBERG

This commentary originally appeared as part of a broader workshop summary. Read speaker bios and learn more from each panelist on a number of related topics at www.rff.org/ca-swedenworkshop.

Florida Ranchlands: An Experiment in Paying for Environmental Services

An Interview with Leonard Shabman



More than eight years ago, RFF Resident Scholar Leonard Shabman, working cooperatively with Sarah Lynch at the World Wildlife Fund, helped launch the Florida Ranchlands Environmental Services

Project (FRESP), a pilot program to address difficult environmental challenges as a result of urban and agricultural develop-

LEONARD SHABMAN: The idea is that a buyer—some entity who has money and is willing to spend it to receive an environmental service, such as improved water quality—contracts with some other entity who is able to provide that service. In the Florida case, an agency of the state was willing to pay cattle ranchers who retained stormwater on their ranches and slowed the rush of water and nutrients toward Lake Okeechobee, beyond what was required of ranchers under their regulatory obligations.

In the Florida case, an agency of the state was willing to pay cattle ranchers who retained stormwater on their ranches and slowed the rush of water and nutrients toward Lake Okeechobee.

ment in Southern Florida. The measure of its success is that in January 2011, the South Florida Water Management District adopted it as the Northern Everglades–Payment for Environmental Services (NE–PES) program. Shabman recently sat down with *Resources* to discuss the program’s design, implementation, and lessons learned.

RESOURCES: What exactly do you mean when you say “payment for environmental services”?

RESOURCES: FRESP was focused on the Northern Everglades. Can you tell us about some of the water challenges in that area?

SHABMAN: If you think about a map of Florida, there’s a big blue spot in the middle of it. That’s Lake Okeechobee. The area called the Northern Everglades is the area that drains from Orlando south into the lake.

The water that reaches the lake is from the rain that falls in that whole area. It used to take a long time to get to the lake.

The lake would slowly rise and fall, and the water from the north would slowly seep into what is now the Everglades Park and then on to Florida Bay.

As a result of development, two things happened. The first was that the system was heavily drained, and a dike was built around the lake. Now rainwater rushes to the lake, making it rise and fall quickly, with adverse effects on habitats and the

RESOURCES: How did the district begin to consider paying ranchers to hold water, and were ranchers initially interested in the pay-for-services concept?

SHABMAN: The district has the responsibility of working with the federal government to bring about the restoration of the whole Everglades system. The federal-state strategy is built around big public

The ranchers were skeptical: What would the water do to their cattle production business? The South Florida Water Management District was also skeptical: Would the ranchers be willing to hold the water?

shoreline. When the lake gets really high, the water is released to the estuaries on the east and west coasts. These sudden rushes of fresh water negatively affect the marine environment. Equally important, nutrients—phosphorus and nitrogen—started moving into the lake and on to the estuaries, creating oxygen-depleting algae blooms.

RESOURCES: How was the drained land north of Lake Okeechobee developed?

SHABMAN: The ditched and drained land allowed certain land uses that would not have been possible otherwise. One response was that vast areas of that land became cattle ranches. The reality is that the extent of land drainage has proved to be more than what is necessary for cattle production. So ranchers might, under certain conditions, be able to hold back water on their land and still have a productive cattle operation. If they would do that, the South Florida Water Management District—the agency responsible for keeping lake level fluctuations in check and improving water quality—could pay them for that service.

works projects—reservoirs and large stormwater treatment areas that could be hundreds or even thousands of acres. But these projects became very expensive and implementation was delayed, so the World Wildlife Fund and RFF began a dialogue with all the stakeholders to see if there might be interest in exploring whether holding back the water on open ranchlands could be a complement to these large public works projects.

The ranchers were skeptical: What would the water do to their cattle production business? The South Florida Water Management District was also skeptical: Would the ranchers be willing to hold the water? We had to develop ways to answer these and other questions. How would ranchers hold water? How could the ranchers show the district the services they would provide? How could the district be sure that it was getting the services that it paid for? How much would the ranchers be paid? The formal collaboration that came to be called FRESA was formed to answer these and other questions.

RESOURCES: What were the water management practices identified by FRESP?

SHABMAN: There are two main things ranchers can do. First, they can put boards in existing ditches to block water from leaving the ranch and perhaps build berms or dikes to hold the water beyond the ditches. The second is to divert water from rivers and canals onto their land and let wetland processes remove the nutrients. Then they discharge the cleaned water back into the rivers and canals and on down into Lake Okeechobee.

RESOURCES: How could the ranchers estimate the services they could provide?

SHABMAN: This was a major challenge that FRESP had to face. In the end, the FRESP partners agreed that all applicants to the program would use the same service estimation models, developed through the FRESP process. These were simple models that had limited data requirements. Each estimate was based on the average rainfall year over the 10-year contract period. In some years the service would be less and in other years more, depending on rainfall.

RESOURCES: Where did the FRESP discussion of payments lead?

SHABMAN: The collaborators agreed that ranchers would submit a proposal with an estimate of how much water they would hold or how many pounds of nutrients they would remove, along with a request for an up-front payment for initial investment costs and then an annual payment for services rendered over the life of a 10-year contract. Based on that submission, the district negotiated with each rancher to find a payment that would be acceptable to both parties.

RESOURCES: How did the district and ranchers monitor contract compliance?

SHABMAN: One very important feature of the FRESP-designed contract was that the rancher was paid as if every year were an average rainfall year. So contract compliance, not the level of the service in any year, was what needed to be monitored. Let's imagine as one example that a rancher agreed to put a board in the ditch. There are two things that the district wants to know. The first thing is that the board is there—that it hasn't been moved. The second is that even if the board is there, the water hasn't been diverted around the board in some other way. The collaborators agreed to check monthly to be sure that the boards were in place. Also, stage recorders and rain gauges were installed at the site. The stage recorder data is collected electronically along with rainfall each day. As long as the water level fluctuates in some logical way, the site is said to be holding water.

RESOURCES: How has the new NE-PES program worked out?

SHABMAN: FRESP ended in January 2011 when the district took the basic design principle and issued a solicitation asking interested ranchers to apply for contracts under the NE-PES program. In May 2011 the district accepted eight contract proposals from among those submitted. A second solicitation period has ended, and new projects will soon be selected. ●

Visit www.rff.org/fresp to find out more about this project.

Regulating Emissions from **BIOENERGY:** *What Life-Cycle Assessments Tell Us*

by Roger Sedjo

Unlike fossil fuels, which have the disadvantage of releasing carbon into the biosphere that can never be recaptured back to its original source, wood chips or pellets, biofuels, and other forest energy products are renewable, and the carbon released in energy production can be recycled indefinitely through a regenerated forest. This fundamental difference is posing a challenge to the US Environmental Protection Agency (EPA) in its formulation of the Greenhouse Gas Tailoring Rule, which regulates various types of carbon emissions from energy production. The question has become, to what extent might a categorical exclusion from regulation be applied considering that all or most of the emissions are ultimately recaptured in subsequent biomass growth?

One approach for examining this question is a life-cycle assessment (LCA) of the carbon emissions associated with bioenergy. Such assessments are commonly used to evaluate the environmental implications of various products and activities, including the net effect on carbon and other greenhouse gas (GHG) emissions. However, a number of different LCA approaches exist, and they can generate very different findings.

At one end of the spectrum is an analysis with narrow, fixed boundaries—such as a particular forest—that looks at a single product over its lifetime while assuming that markets, prices, and investments are unchanged

by the use of the product. At the other end of the spectrum is an LCA that incorporates changes in markets, prices, and investment levels directly attributable to the use of the forest products.

Comparing two case studies in the literature shows how the results can diverge. One influential study—undertaken by the non-profit conservation group Manomet—used an LCA to examine the amount of carbon released and subsequently resequenced from the wood harvested from a single forest site for bioenergy. The study was commissioned by the state of Massachusetts to help inform the legislature about the feasibility of substituting wood biomass for coal in some of its electrical power generation. A concern of the legislature was meeting near-term emissions reduction targets.

The study found that in the near term, the carbon released by the wood biomass was somewhat greater than the carbon that would have been released by the coal it replaced. However, after a period of 32 years of regrowth, the carbon sequestration by the regenerating forest would have completely recaptured all the excess carbon emitted earlier. Furthermore, additional tree growth beyond 35 years would generate net positive sequestration compared to the situation where wood would not replace fossil fuels.

In another LCA study, I used a forward-looking model to examine a multi-site forest

system. This approach incorporates changes in market conditions, including associated changes in harvests and investments in forest stocks. We found that as more bioenergy is demanded and enters the market, companies respond by investing in forest expansion to meet anticipated future demand. Thus, even in the short-term, the stock of the forest system will be maintained or expanded, thereby eliminating most or all of the short-term net carbon emissions while generating net emissions reductions over time.

The different results of various LCAs have generated confusion among regulators. But even with their differences, the entire

range of studies indicates that declines in forest carbon sequestration associated with increased harvests for bioenergy would be offset by new forest growth given sufficient time. This clearly suggests that EPA should treat biomass emissions separately from the irreversible emissions of fossil fuels. ●

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Help Endow the RFF Chair in Forest Economics and Policy

Ensuring the Future of Independent Forestry Research

Now more than ever, today's leaders need independent, sound approaches to environmental and natural resource challenges. RFF's Forest Economics and Policy Program has provided trusted solutions to those challenges for the past 30 years. Looking forward, RFF is working to guarantee that the program continues to be an active resource for the health and management of forests—and to the communities and industries that depend on them.

RFF has committed a cornerstone gift, and the US Endowment for Forestry and Communities stepped forward with a significant challenge grant to endow a new RFF Chair in Forest Economics and Policy. This position will allow RFF to continue advancing great ideas about timber markets, wood biofuels, forest conservation, forest carbon, and all aspects of the global challenges related to smart forest management. By taking this proactive step, RFF and other leaders in the forestry community are ensuring that a balanced perspective on forest policy remains available and active in perpetuity.

RFF is on its way to making the RFF Chair in Forest Economics and Policy a reality, thanks to the leadership of the following donors:

**Plum Creek
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For more information about supporting this chair, please contact Lea Harvey, RFF vice president for development, at harvey@rff.org or 202.328.5016.

Evaluating New Approaches to Increase **FUNDING FOR STATE PARKS**

by Margaret A. Walls



The 14 million acres of state park lands across the United States provide enormous social and economic benefits. For many Americans, family vacations in state parks are some of their earliest memories of connections to nature and the outdoors. These parks continue to provide relatively easy and low-cost access to outdoor recreational experiences, and in some states, particularly in the East and Midwest, they provide outdoor experiences that are not available from national parks and other federal lands, which tend to be predominantly in the West. And yet it has become clear in recent years that state park systems, by and large, are struggling. The problem? Funding.

General fund revenues for state parks have declined precipitously since the 1990s,

and the recent recession exacerbated an already difficult funding situation in many states. Since 1990, the share of total state park funding from general revenues has fallen from close to 60 percent to under 35 percent. This leaves states with tough questions on both the expenditure and revenue sides of the ledger.

In terms of expenditures, should they close some parks? Are there ways to lower costs without compromising the amenities and services that parks provide?

On the revenue side, lawmakers are pursuing alternatives to funding parks through general revenues, which are unlikely to be sufficient in most states to fully meet current state park financial requirements—much less the costs of expansion through new parks and acreage. Alternative options

include user fees, various kinds of dedicated taxes and other revenue sources, voluntary contributions, corporate sponsorships, and partnership arrangements—with local governments, park conservancies and foundations, and private industry.

Which options hold the most promise? In truth, the diversity of park systems across the 50 states and variation in the degree of severity of their funding problems means that no single approach can be recommended. Each has advantages and disadvantages.

» User fees: Fees are appropriate for many of the services that parks offer, such as overnight campground stays, lodging, and equipment rentals. Fees are also an effective way to manage congestion. But overreliance

on sales taxes, real estate fees, vehicle registration fees, and other sources. These “earmarked” taxes can give state park systems a reliable source of funds, but they nearly always lead state legislatures to cut back general fund revenues, sometimes to zero. And some earmarked taxes, especially those with a narrow tax base, are unlikely to generate substantial revenues. Having a broad tax base is also important to ensure that the burden on individual households is small.

» Voluntary private contributions: Following the lead of many major cities, such as New York, some states are increasing their efforts to attract philanthropic gifts. State park endowment funds hold particular promise. However, raising funds from

Since 1990, the share of total state park funding from general revenues has fallen from close to 60 percent to under 35 percent. This leaves states with tough questions on both the expenditure and revenue sides of the ledger.

on fees can sometimes inefficiently ration park use. And many aspects of parks, such as hiking and biking trails and scenic views, are nonrival public goods that should not be priced.

» Privatization: Contracting with private firms can inject new ideas and creativity into the management of parks and may yield cost savings through private-sector efficiencies. However, contracting can be costly. State park agencies need to carefully weigh the full cost of the contract approach—which includes the government’s cost of writing and enforcing the contract—with that of public provision.

» Dedicated public funds: There has been a recent move toward dedicated public funding systems that rely on lottery reve-

donations can be costly and somewhat unreliable, so even in a best-case scenario, philanthropy is unlikely to provide the majority of funds for state park operations.

In most states, the current funding model is not working. Fresh approaches to financing and managing parks and open space are needed. As legislators examine their options, it will be helpful to also keep in mind that state park problems often go beyond money. Some park systems have not kept up with changing demographics and preferences, and management structures in some systems seem to stifle creativity and innovation. Improving the financial viability of state park systems is a necessary step, one that belongs in the context of wider-ranging reforms. ●





The **Endangered
Species Act**
at **40**

NEW TOOLS FOR CONSERVATION

Marking the 40th anniversary of the ESA, Lynn Scarlett, Rebecca Epanchin-Niell, and Matthew McKinney take stock of emerging solutions to major conservation challenges.

Like so many environmental statutes, the Endangered Species Act (ESA) was launched 40 years ago affirming lofty values. The ESA begins, “The Congress finds and declares that . . . species of fish, wildlife, and plants are of esthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people.” Through the act, Congress strived to “provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species.”

The ESA traditionally has taken a species-by-species approach that constrains the ability to focus on the health of ecosystems.

The first four decades of implementing the ESA yielded successes and conflict, but much of the discourse has circled around the conflict: Does the ESA overly burden private landowners? Does it protect species at the expense of human well-being? Is it cumbersome, costly to implement, and inefficient? Does it spawn recurring litigation over timelines and process, while contributing little to actual species recovery? Volumes of critiques of the ESA and its implementation have explored these questions.

The verdicts of these inquiries vary, sometimes dramatically. However, the ESA has clearly played a significant role in bringing attention to species at risk of extinction. Although many species remain imperiled, less than 1 percent of the 2,000 listed species have actually gone extinct. And the ESA has compelled significant planning and changes in land management practices to reduce adverse impacts to species that are threatened or in danger of extinction.

Despite some conservation achievements, the implementation of the ESA—and thus future species conservation—faces at least four major challenges:

- » Policy tools to engage private landowners, who hold keys to the survival and flourishing of many species, are often cumbersome and insufficiently evaluated for their actual outcomes.

- » Threats to species involve complex, interconnected changes to ecosystems—the spread of invasive species, altered fire regimes, land development, pollution, and the many effects of a changing climate—that often unfold at the landscape scale. Yet

the ESA traditionally has taken a species-by-species approach that constrains the ability to focus on the health of ecosystems.

- » Many of these threats involve significant uncertainties about the pace, scope, and extent of changes and their implications.

- » Traditional public sources of conservation funding are highly constrained.

Several options have emerged to address these four challenges. The ESA is sufficiently broad and general to accommodate most—if not all—of these improvements.

Refine Incentives to Engage Private Landowners

Privately owned lands play an important role in species protection: more than two-thirds of endangered or threatened species make private lands their home, and one-third may be found exclusively on private lands. Yet the ESA initially created disincentives to landowners for species protection because having a listed species on one’s land invoked regulations that could require

potentially costly restrictions on land use. Over the past 20 years, many innovations have softened these disincentives, and the US Fish and Wildlife Service (FWS), charged with implementing the act, continues to add to and hone these innovations.

Some of these tools, such as conservation banks and recovery credits, create economic incentives for landowners to engage in stewardship of threatened and endangered species. Conservation banks, set up through agreements with the FWS, offset adverse impacts to species on other lands or from other projects. Each bank is allocated a specified number of credits that can be sold to entities needing to compensate for unavoidable impacts to species, thereby creating revenue for the bank owner. By July 2012, more than 100 conservation banks had been approved by the FWS in 11 states, covering some 60 threatened and endangered species on 790,000 acres.

Similarly, federal agencies can support actions on non-federal lands that benefit target species and in return receive “re-

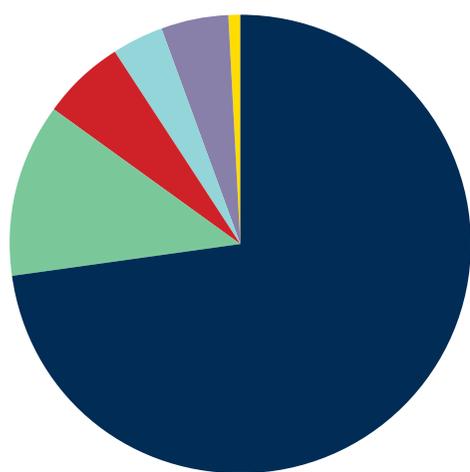


covery credits” to offset negative impacts of federal actions. These credits provide flexibility to federal agencies as they seek to fulfill their missions and revenue to the private landowners selling the credits.

The FWS also uses habitat conservation plans (HCPs) to engage private landowners in species conservation. These plans set forth management approaches to minimize adverse impacts to species and enhance conservation of their habitat in order to support recovery. By 2012, the FWS had approved 710 plans (and approved nearly 800 related permits). The plans cover more than 40 million acres and hundreds of species. But limiting their efficacy, many of these plans focus on a single species and cover land parcels of less than 100 acres; only 5 percent cover 100,000 acres or larger, primarily in the Pacific Southwest (see Figure 1 at left).

Several recent developments in the design and implementation of HCPs have significantly improved wildlife conservation

Figure 1. Habitat Conservation Plans by Size



and landowner engagement. Some HCPs embrace large landscapes, including both public and private lands. Others cover multiple species, including unlisted species, and address cross-cutting threats.

Consider a few examples:

» The city of Seattle prepared an HCP for 83 species (7 listed and 76 unlisted). The plan addresses a variety of natural resource issues within a 90,545-acre watershed that

Washington. The plan covers 17 species of native fish, including 8 species listed as threatened or endangered. Another Plum Creek initiative, their I-90 HCP, covers more than 25 listed and 20 unlisted species on nearly 170,000 acres that include coniferous forests, aquatic and riparian habitat, and wetlands.

» One HCP under development between the FWS and a natural gas company will

Conservation problems unfold at large scales, and solving them requires combined public and private actions across human-made boundaries.

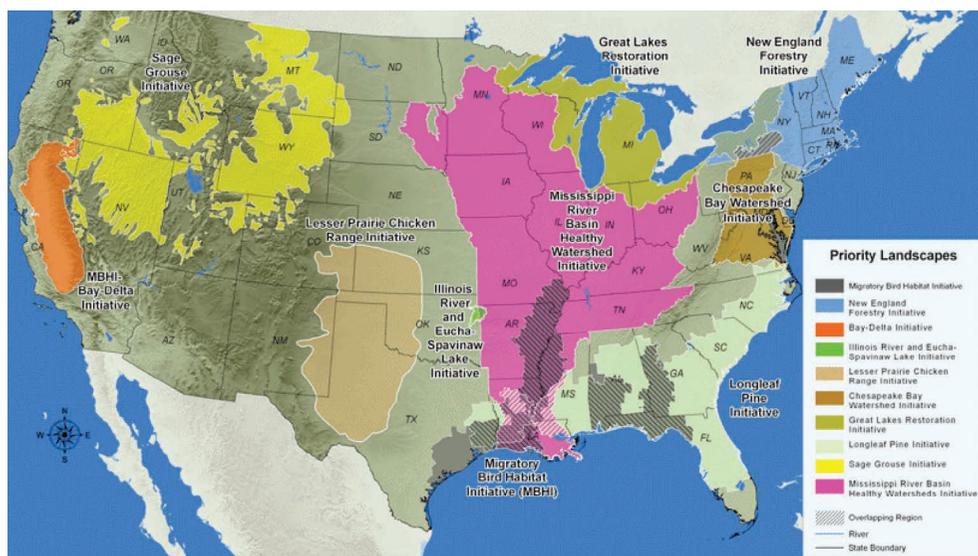
includes the city's water supply. The plan requires that the city engage in negotiations with five state and federal agencies to coordinate issues and conservation responses, such as maintenance of instream flows and fish passage.

» Plum Creek Timber Company entered into an HCP agreement with the FWS and the National Marine Fisheries Service for 1.6 million acres in Montana, Idaho, and

cover 43 federally listed and candidate species. The HCP could stretch along 15,000 miles of right-of-way and ancillary facilities in an area spanning 14 eastern and central states on 9 million acres of land.

These incentive-based tools present some administrative challenges, including burdensome and time-consuming procedures. Nonetheless, they provide an essential platform to engage private landowners

Figure 2. Natural Resources Conservation Service Priority Landscapes, 2011–2016



Source: Conservation beyond Boundaries: NCRS Initiatives. www.nrcs.usda.gov/initiatives/index.html.

in species conservation, though measures to make them more user friendly could expand their use.

Promote and Support Large-Landscape Conservation

Nature is characterized by interconnections, synergies, and interdependence. Species often function across landscapes and ecosystems regardless of legal and administrative boundaries. Conservation problems unfold at large scales, and solving them requires combined public and private actions across human-made boundaries. These challenges put a premium on developing tools for cross-jurisdictional, public-private, and private-private coordination and cooperation.

Collaborative leaders from the public and private sectors are coming together in a variety of formal and informal arrangements to catalyze large-landscape conservation initiatives. These initiatives—often experimental in nature—can enhance species conservation in many ways, such as strengthening the performance provisions with clearly articulated metrics for habitat and species conservation.

The US Department of Agriculture’s Natural Resources Conservation Service (NRCS) currently supports several landscape-scale initiatives through its implementation of multiple conservation programs under the farm bill (see Figure 2 on page 24). Many of these fall under the umbrella of NRCS’s Conservation beyond Boundaries project. These initiatives build upon existing local partnerships, receive dedicated funding to enhance implementation, use science to inform management practices, and assess performance and outcomes. They are moving beyond what former NRCS chief Bruce Knight called “random acts of conservation” by targeting resources from a variety of NRCS programs to high-priority needs



of a given geographic area. The goals of these initiatives are to leverage action and enhance consistent practices through partnerships, focus funding to achieve specific and transparent results, and expand capacity to accelerate action.

Consider the NRCS’s Sage-Grouse Initiative. Covering activities in 11 states, it seeks to coordinate actions with federal agencies, states, and landowners to reduce threats to the sage grouse, a species of ground-dwelling birds native to the western sagebrush ecosystem. The sage grouse population has experienced a precipitous decline as rangelands are converted to subdivisions, invasive pines encroach on grasslands, and unsustainable grazing practices reduce ground cover. Actions have included moving or “marking” 180 miles of fence near breeding grounds, improving grazing systems on 640,000 acres, and removing 40,000 acres of encroaching conifers. To help engage ranchers in the program, NRCS and its partners have identified 40 conservation practices that are benign or beneficial to sage grouse so that participating land-



owners will not face additional restrictions or regulations if the sage grouse joins the list of federally threatened or endangered species.

These and many other large-landscape initiatives point the way to future opportunities for species protection that combine ESA incentive programs with other conservation efforts to engage landowners in species protection at landscape scales.

Increase Collaborative Adaptive Management

Uncertainties and complexities complicate efforts to protect at-risk species. Initiatives that integrate science and action into an adaptive decision process through collaborative efforts that engage multiple stakeholders and agencies have the potential to improve species outcomes by reducing uncertainties, improving management, and reducing stakeholder conflict. This newly emerging paradigm is often referred to as

collaborative adaptive management.

A good example is the Platte River Recovery Implementation Plan, a basin-wide initiative focused on protecting four listed species. Meeting the needs of the species requires changing water flows, better managing groundwater, and land conservation measures, but water users disagreed on what actions to undertake. Participants in this effort—federal and state agencies, local landowners, the agricultural community, hydropower managers, and others—developed a collaborative adaptive management process in response to stakeholder and decisionmaker disagreements and scientific uncertainties. The process has helped participants set common goals, implement strategies to achieve those goals, and develop new information on the effectiveness of those strategies—providing a way to transcend data disagreements and uncertainties and move to actions to protect species while still providing water for other uses.

In the face of uncertainties associated with a changing climate and other land-use and demographic changes, use of collaborative adaptive management processes within the context of ESA decisionmaking can provide for ongoing learning and enable adjustments to conservation actions based on that learning. A collaborative adaptive management framework is now used to manage threatened and endangered species, but there are significant opportunities to broaden use of this kind of framework as a means of better addressing uncertainties (and scientific disagreements).

Leverage Funding through Coordinated Actions

Many federal, state, and nonprofit programs support conservation planning, cross-agency coordination, and investments through grants, direct program support, and other resources, which can be leveraged for

species conservation. Jointly, these programs provide significant conservation funding. For example, the 2008 farm bill includes total mandatory spending for conservation provisions of \$24.3 billion over five years (2008 to 2012). These programs represent 15 percent

nered to reduce fuel loads in the municipal watershed, funded by water ratepayers. In Oregon's McKenzie Watershed, the Water and Electric Board is paying farmers for reduced use of pesticides and nitrates. Although funding for these water services is

The conservation and recovery of species will become increasingly complex in the face of climate change, water scarcity, and land fragmentation. The ESA provides an effective framework to meet these challenges.

of total farm bill spending and the most significant national sources of conservation support for stewardship of private land.

However, future funding through public sources, especially at historic levels, is unlikely given budget constraints. Thus, non-traditional sources of financing may become increasingly important to sustaining protection of species and implementing recovery plans. One promising type of financing tool involves investments in natural systems that help sustain water supplies, enhance water quality, or protect coasts from storms. These investments include wetlands mitigation banks and conservation banks associated with meeting regulatory requirements and conservation management concessions. They also include ratepayer-funded "water funds" to conserve source water, enhance forest health, mitigate flood damage, and achieve other benefits.

In one such program, Salt Lake City is making payments for watershed protection, using water bill surcharges to buy watershed lands and conservation easements to protect the city's water supplies. The city has also entered into an agreement with the US Forest Service to protect watershed lands outside of city limits. In Santa Fe, the US Forest Service and the city have part-

not specifically directed at species conservation, there are opportunities to leverage such funding to achieve multiple goals.

The conservation and recovery of species will become increasingly complex and challenging in the face of climate change, water scarcity and variability, and land fragmentation. However, the ESA provides an effective framework to meet these challenges, particularly as efforts pivot away from a species-by-species approach and toward incorporating species protection within larger, landscape-scale efforts that use incentives to engage private landowners and nonprofit partners.

In a forthcoming RFF report, we will examine in more detail what administrative and legislative provisions as well as scientific and funding tools could further support this shift. ●

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Designing a
FAIR CARBON TAX

*Drawing from more than 20 years of economic study, **Daniel F. Morris** and **Clayton Munnings** argue that the regressive impacts of a carbon tax can be addressed by well-crafted policy.*

In some circles, a tax on carbon dioxide emissions is presented as a bogey-man that will make poor people even poorer. As quiet discussions continue about the viability of carbon taxes to help address the nation's fiscal issues, the potential impacts to low-income groups from higher energy prices will no doubt be used to fight against progress. Economic research from the past few years, however, suggests the negative effects of carbon taxes on these groups are not as extensive as politicians would tell us.

Although putting a price on carbon may possibly have regressive impacts, economic estimates can overstate these impacts by using short-term or nonrepresentative income measures. In fact, some research suggests that a carbon tax may even be progressive in certain cases. Moreover, it would not be difficult to craft market-based control policies that protect vulnerable classes of citizens while reducing the country's greenhouse gas emissions.

In a recent RFF issue brief, we underscore both these points. We surveyed more than 20 years of economic study to determine how households are impacted by carbon taxes and how to limit or offset income losses to low-income populations. The results provide some useful guidelines for designing carbon taxes in the United States. Critical findings include the following:

- » Carbon taxes are probably not as regressive as they are often characterized, and they appear even less regressive when using measurements based on annual household consumption or accounting for tax effects for producers. In some cases, they may be slightly progressive.

- » Regional differences in the effects of a carbon tax are small.

- » Government programs that index to inflation may contribute to a more progressive tax.

- » Low-income households can be compensated for increased prices with carbon tax revenue. If it is returned through direct rebates, the results will be progressive and reach more households, but targeted tax swaps may have similar effects.

Impacts to Households

What do economists currently think the consequences of carbon pricing are for low-income populations? Some studies suggest the income burden from pricing carbon may be as high as 3.5 percent for low-income households, but less than 1 percent for high-income households. If accurate, then a carbon tax is clearly regressive. These studies, however, may overestimate regressivity due to three simplified but important assumptions.

The first assumption is that producers can pass 100 percent of increased carbon charges through to consumers in the form of higher prices. Second, some researchers characterize impacts to households by measuring the tax burden as a portion of annual income instead of annual consumption. Finally, some studies assume that social safety net programs do not dampen the impact of pricing carbon on low-income households.

Cost Pass-Through

The first step to measure the effects of carbon taxes on low-income groups is to understand how carbon taxes reverberate through the economy to impact consumers—often called the tax incidence. The three most important pathways through which environmental taxes can be felt are increased costs to consumers, lower production or increased costs for businesses, and the value of tax revenue. If one makes the assumption that 100 percent of the tax will be passed through to households, then the tax could be quite regressive. Many studies

do assume that producers can completely pass increased costs on in the form of higher energy prices. They also assume that consumers would not reduce their energy consumption, despite higher prices, which means that a carbon tax would not impact producers whatsoever.

In reality, producers will bear some proportion of the costs, which may result in reduced returns on investment and lowered wages. The burden of these impacts would fall on richer households that draw a disproportionate share of income from investing in—and working for—producers. Allowing producers to change their labor, capital, and emissions profile and consumers to change their energy consumption in economic models will generate more realistic results and give a more complete picture of the impacts to households.

Annual Income versus Consumption

The conventional argument is that carbon taxes are regressive like sales taxes are regressive: richer households purchase more goods and therefore pay more sales tax in absolute terms, but sales tax payments constitute a larger fraction of low-income households' annual income. When using the impact of a consumption tax on households as a portion of annual income as the metric, the burden falls disproportionately onto low-income households.

But annual income does not necessarily give an accurate representation of a household's well-being. Measuring household impacts in terms of annual income may overstate regressivity for two reasons. First, households' annual income can vary drastically from year to year; temporarily unemployed workers are a good example. Second, households' annual income generally increases over time. The income of a fourth-year PhD candidate likely will increase substantially after graduation—

reducing the proportion of income that goes to taxes. Both examples demand a concept of income that appropriately accounts for long-term trends.

Economists could accurately characterize household impacts by comparing tax burdens to lifetime income, but that estimation is difficult and speculative. Economists therefore use a work-around that contends annual consumption is a reasonable proxy for lifetime income. Measuring incidence as a portion of annual consumption instead of annual income results in quite different findings. A 2010 study conducted by economists Corbett Grainger and Charles Kolstad finds that a carbon price appears two to three times more regressive when measured in terms of annual income rather than annual consumption. In fact, the authors find that a carbon price has an almost neutral impact on households when measured in terms of annual consumption.

Social Safety Nets

Until recently, most researchers neglected the role that inflation indexing plays in protecting low-income households from the impacts of pricing carbon. A tax on carbon would increase energy prices and possibly boost inflation, which could actually benefit low-income households in a number of ways. Many government assistance programs are indexed to inflation so that low-income participants are not unduly affected. Thus, as inflation increases, transfer payments such as Social Security, workers' compensation, and veterans' benefits also increase. Inflation indexing has progressive effects because transfer payments constitute a disproportionate amount of income for low-income households. Additionally, the government adjusts income tax brackets in response to changes in inflation rates, which may result in some households dropping down to a bracket

with lower tax rates. Lastly, increased inflation can expand eligibility for and increase payments from the Earned Income Tax Credit—payments that disproportionately accrue to low-income households. Neglecting these benefits tends to lead to an exaggerated regressive estimate of carbon pricing impacts.

A 2012 study conducted by RFF researchers Joshua Blonz, Dallas Burtraw, and Margaret Walls accounts for each of these benefits and confirms their progressive effect. According to the findings—which were for a cap-and-trade system—the three lowest income quintiles benefit substantially from inflation indexing, while the top two income quintiles experience a minor increase in costs. The effect of transfer indexing is strong enough to turn an estimated 0.25 percent burden from the tax into a 0.13 percent gain for households in the lowest income quintile.

power. But those regions that are more reliant on fossil fuel currently pay less in electricity prices, so research suggests that a carbon tax will result in a price flattening across the nation.

Although this is the case for electricity prices, a carbon tax may affect the price of other types of energy—such as gasoline and home heating oil—differently across the country. Despite that, it may have similar effects on household income in different regions. A 2012 study conducted by RFF researchers Karen Palmer, Anthony Paul, and Matthew Woerman finds that the tax burden for average households clusters around 1.5 percent of annual income, despite the fact that regions consume energy differently. For example, Appalachia spends more on gasoline than New England, where households spend more on heating oil. This suggests that although energy consumption of specific fuels varies by region,

Regions that are more reliant on fossil fuel currently pay less in electricity prices, so research suggests that a carbon tax will result in a price flattening across the nation.

Regional Effects

Just as carbon tax impacts will be felt differently across income groups, regions of the country will face different impacts. Although existing economic models cannot deliver reliable estimates about household impacts in specific cities or congressional districts, clear regional patterns arise from a national carbon price.

The electricity sector will most prominently exhibit regional disparities in price increases. Areas of the country that depend more on fossil fuel for electricity production will see greater price increases than areas that use renewable sources or nuclear

overall energy consumption is such that the carbon tax does not significantly disadvantage households in any specific region.

In general, economists tend to find modestly regressive to slightly progressive impacts of carbon pricing when making assumptions that accurately reflect reality. The recent research confirming these results marks an evolution in academic thinking and a departure from the view that carbon taxes are just like a sales tax.

Offsetting Tax Burdens

Although a carbon tax may be less regressive than it appears at first blush, it still is

potentially more burdensome to low-income households than to wealthier households. The direct and indirect burdens of the tax, however, are only part of the story. The carbon tax discussion is incomplete with-

be more economically efficient than targeted low-income assistance programs.

Researchers at RFF recently developed a new model of the US economy designed to help policymakers navigate this complex

The government can make the tax fully neutral or even progressive by directing some amount of revenues to low-income households.

out including the use of revenues generated from the tax. The government can make the tax fully neutral or even progressive by directing some amount of revenues to low-income households, through either direct rebates or swaps to reduce other, more distortionary taxes.

The direct-rebate route is straightforward: the government would simply send checks to all eligible households. Although all households would benefit from the rebate, the lowest 20 percent would likely see the greatest gains. This approach was a key component to the proposed Cantwell–Collins cap-and-trade bill in the 111th Congress, and the direct rebate has remained popular in some circles because of its administrative ease.

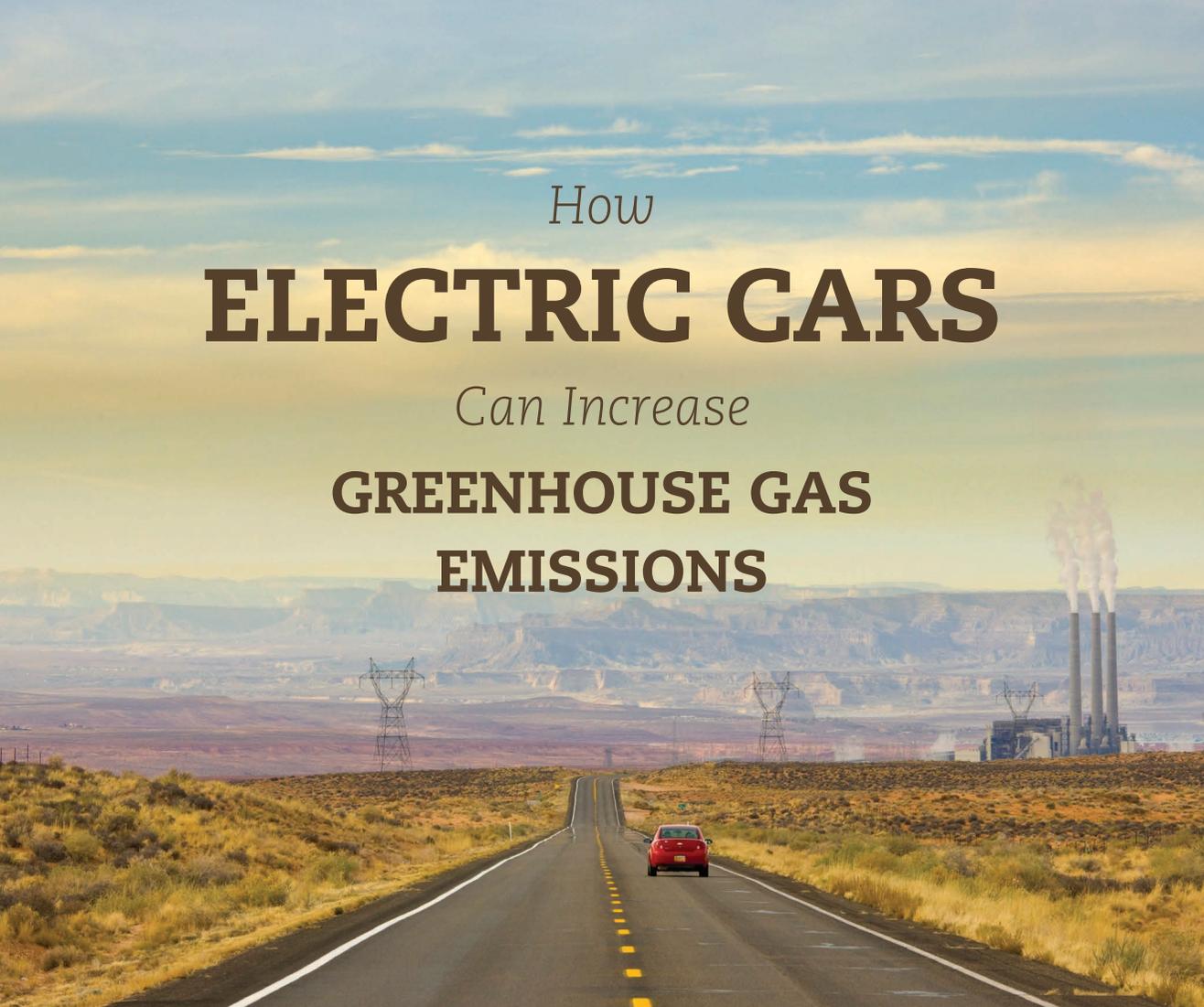
Direct rebates are not the only solution. Tax revenue swaps have gained bipartisan support over the past year as a way to reduce distortionary taxes and begin to get the country's financial house in order. For households, this approach would consist of reducing income or payroll taxes (or both) by the same proportion of income that goes to the carbon tax. Depending on the distortionary tax being offset, the swaps could enhance economic efficiency, though possibly to the detriment of equity concerns. For instance, swapping carbon tax revenue to reduce income or corporate taxes may have a more regressive outcome than reducing payroll taxes, but they may

array of options. The model can be used to analyze the economic, distributional, and environmental impacts of a federal carbon tax for current and future generations across the country. The model also examines the most efficient uses of revenue from a carbon tax—for example, to support revenue-neutral tax reform, reduce the deficit, or provide rebates to consumers.

While there is still much to learn about how a carbon tax might work within the US economy, worries about detrimental effects to low-income populations should not be used as a barrier to implementation. A carbon tax is a policy that can gird vulnerable populations against both environmental degradation and economic hardship. ●

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How
ELECTRIC CARS
Can Increase
**GREENHOUSE GAS
EMISSIONS**

*Under existing fuel economy and electricity policies, subsidies for plug-in vehicles may have the opposite effect on vehicle emissions than intended, warn **Joshua Linn** and **Virginia McConnell**.*

Substantial subsidies exist for vehicles that use electricity from the power grid, which includes vehicles that either run entirely on electricity (such as the Nissan Leaf) or are capable of using gasoline or electricity (the Chevy Volt, for example). The subsidies take the form of tax credits of \$7,500 to more

than \$10,000 per vehicle, government incentives for home charging equipment, and access to high-occupancy vehicle lanes.

The motivation for these policies is that many consider electric vehicles to be essential for achieving the long-term goals of dramatically reducing vehicles' oil consumption



and greenhouse gas (GHG) emissions. In reality, GHG reductions are not a given. The net effect of electric vehicles on emissions will depend on the mix of electric vehicles and other vehicles in the fleet—which are influenced by the Corporate Average Fuel Economy (CAFE) standards—and on emissions from the electricity used to power the vehicles (upstream emissions), which are influenced by policies at federal and state levels.

Accounting for these interactions, subsidies for electric vehicles have the potential to increase, not decrease, the average emissions rates of new passenger vehicles. Offsetting this increase would require strong complementary policies to reduce electricity-sector emissions. Subsidies for electric vehicles to increase their penetration into the fleet therefore need to be justified on other grounds, such as manufacturers or consumers learning about new electric vehicle technologies, which could have spillover effects to other manufacturers or consumers.

How the CAFE Program and Electric Vehicle Crediting Work

As part of the CAFE program, the US Environmental Protection Agency (EPA) essentially sets an average GHG emissions rate for cars and light trucks sold each year. For each manufacturer subject to the program, the sales-weighted average emissions rate must equal a particular level that depends on the size mix of the vehicles sold by the manufacturer. The GHG emissions rate is inversely proportional to the vehicle's fuel economy—so setting a lower emissions rate standard is equivalent to setting a higher fuel economy standard.

The fact that the program fixes the average emissions rate at a stricter level than auto companies would attain on their own implies that vehicle subsidies have an unexpected effect. Consider a simple hypothetical, in which a manufacturer sells an equal number of two types of vehicles: one that has an emissions rate below the standard, such as an electric vehicle, and another that has an emissions rate above



the standard. The sales-weighted average emissions rate of the two models exactly equals the standard. If the government then decides to subsidize sales of the low-emissions vehicle—say, by offering a tax credit—the sales of that vehicle would increase. However, the manufacturer’s sales-weighted emissions rate would now lie below the level of the standard. Recent research (by RFF Senior Fellow Virginia McConnell and Tom Turrentine of the University of California, Davis, and by RFF University Fellow Lawrence Goulder and colleagues) makes the case that the manufacturer would respond by increasing the emissions rates on the high-emissions vehicles, increasing sales, or both to exactly meet the standard.

But under the most recent extension of the CAFE program, EPA allows an additional subsidy to electric vehicles, beyond the federal tax credit and other subsidies, which could actually cause the average emissions rate of new vehicles to increase. Under the reformed CAFE standards for

2017–2021, manufacturers can count each all-electric vehicle they sell as two vehicles for computing the sales-weighted average emissions rate. (This multiple will decline to 1.7 over time to the 2021 model year.) The actual sales-weighted average emissions rate is therefore higher than the standard even though the manufacturer is in compliance, and the overcrediting could increase the average emissions rate. Whether it does depends on electricity-sector emissions.

Electricity-Sector Emissions

The new CAFE policy is complex, but it basically allows manufacturers to effectively assume zero upstream GHG emissions from electricity generation to power electric vehicles. But actual GHG emissions from the electricity sector will differ based on electricity-sector emissions policies around the country. The three cases below demonstrate the different ways that electric vehicles can contribute to electricity-sector GHG emissions.

Case 1: No Greenhouse Gas Policy in the Electricity Sector

Because actual electricity-sector emissions for all-electric vehicles are greater than zero, selling an additional electric vehicle raises the average emissions rate of new vehicles—and this increase occurs above the increase caused by overcrediting that was discussed earlier.

But just how large are these electricity-sector emissions? Let's consider a single driver plugging into the grid at a particular time and location. Doing so raises electricity demand. Some generator, somewhere in the grid, must then increase electricity generation. If that generator runs on coal, greenhouse gas emissions increase even more than if that generator is gas fired. Therefore, the electricity-sector emissions depend on when and where the driver plugs in the vehicle. For example, charging at an off-peak time in a coal-powered region will have a much different effect than during a peak time in an area that receives more power from natural gas. Recent research by University of California, San Diego, economist Joshua Graff Zivin and colleagues suggests that in most regions of the United States, the emissions rates of so-called zero-emissions electric vehicles are comparable to that of a Toyota Prius hybrid—and in some cases are higher than even the average gasoline-powered car.

Case 2: An Emissions Cap for the Electricity Sector

In the opposite extreme from the no-policy case, a cap-and-trade program sets a maximum level of emissions from the electricity sector. Plugging into the grid doesn't affect electricity-sector emissions at all. Electricity demand increases when a driver plugs into the grid, but some change in the power system—perhaps replacing coal-fired generation with natural gas-fired generation—

must occur so that total emissions from the power sector do not change.

This principle underlies California's zero-emissions vehicle program, which requires a certain level of sales of vehicles with qualifying technologies, such as electric vehicles. Because California caps emissions from about 85 percent of its economy, the zero-emissions program does not count emissions associated with electricity generation. However, this accounting is correct only if there is no emissions leakage—that is, if none of the reduction in emissions counted toward California's cap is offset by an increase in emissions from sources not included in the cap. With some leakage, an increase in electricity demand caused by plugging in an electric vehicle could increase total greenhouse gas emissions.

Case 3: An Emissions Rate Policy for the Electricity Sector

When an electricity policy affects the average carbon dioxide emissions rate for electricity generation, how electric vehicles contribute to electricity-sector emissions becomes more complex. Some existing policies, most notably renewable portfolio standards (RPS), effectively reduce the average emissions rate of the electricity sector. Typically, an RPS requires that renewable technologies, such as wind and solar, account for a predetermined fraction of total electricity generation.

Why would an RPS or similar policy matter? The research on electricity-sector emissions cited earlier focused on the short run—that is, how plugging into the grid affects total emissions without accounting for investment in new generators. However, a long-term increase in electricity demand, such as that caused by the purchase and use of a single electric vehicle, causes a small amount of investment in new generation capacity. With an RPS,



renewables would have to account for at least some of this investment. This effect could cause the emissions associated with plugging into the grid to be less than suggested by the short-run analysis. How much less depends on the stringency of the RPS and other factors.

Conclusions

Because the CAFE program fixes the average GHG emissions rate of new vehicles sold, it is easy to assume that the sale of an additional electric vehicle will not affect this average rate. However, because the program overcredits electric vehicles and ignores electricity-sector emissions, each electric vehicle is likely to increase the average rate of emissions. Policies that reduce emissions rates from the electricity sector, such as an RPS, can mitigate this effect but do not completely eliminate it—only an emissions cap or its equivalent can do that. Although these conclusions do not imply that subsidies or preferred treatment for electric vehicles are unwarranted, they do mean that such policies must be justified by other possible market failures.

For example, one manufacturer may learn from another manufacturer’s design of an electric vehicle. Such innovation spillovers could justify additional subsidies. Alternatively, if consumers have incomplete information about the performance or reliability of the vehicle, subsidies encouraging the use of such vehicles could stimulate learning about these vehicles across the broader population. ●

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THE NATIONAL FLOOD INSURANCE PROGRAM: *Directions for Reform*

*As Congress considers legislative changes to the debt-ridden National Flood Insurance Program, **Carolyn Kousky** discusses four key issues for reform.*



Created in 1968, the National Flood Insurance Program (NFIP), housed in the Federal Emergency Management Agency (FEMA), provides flood insurance to residents of participating communities. The program was established in response to the perception that flood coverage was not widely available on the private market. Today, homeowners can purchase up to \$250,000 of building coverage and up to

Increasing Take-Up Rates

Low take-up rates for flood insurance have long plagued the program. This led Congress early on to make the purchase of flood insurance mandatory for homeowners in mapped 100-year floodplains with a loan from a federally backed or regulated lender. After a slow start, the number of policies in force nationwide grew rapidly, leveling off only in the past few years, as shown in

The NFIP paid out more claims in 2005 than it had paid over the life of the program and went deeply in debt to the US Treasury. Hurricane Sandy has only deepened that debt.

\$100,000 of contents coverage through the NFIP. Business coverage is also available. The federal government bears the risk, but private insurance companies write policies and process claims in exchange for a fee.

Because of historic decisions about pricing, the program was ill prepared to handle the catastrophic flood year of 2005. The NFIP paid out more claims that year than it had paid over the life of the program and went deeply in debt to the US Treasury. Hurricane Sandy has only deepened that debt, with Congress needing to increase the NFIP's borrowing authority to more than \$30 billion in 2012.

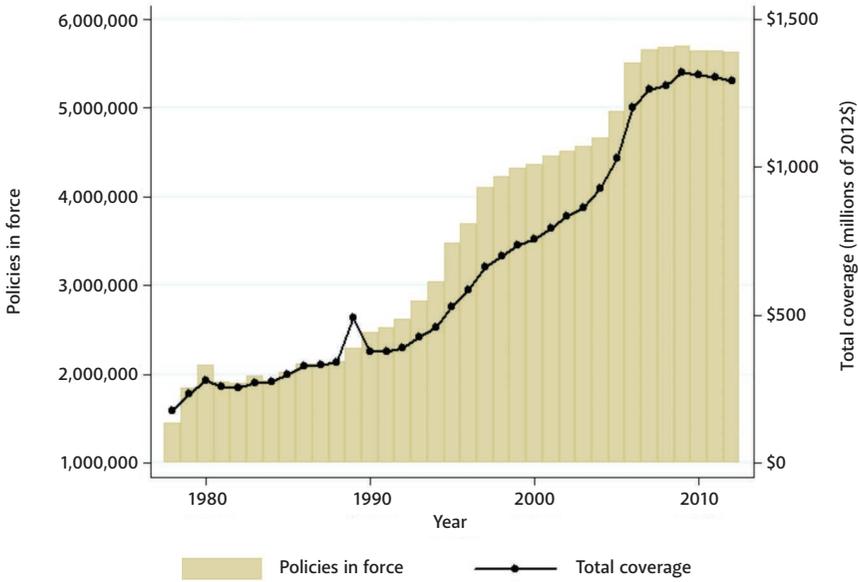
The debt and other issues generated strong interest in reform of the program. After multiple short-term extensions and debate on reform options, the Biggert-Waters Flood Insurance Reform Act passed with overwhelming bipartisan support in early July 2012. As some of the legislation's impacts begin to take effect, Congress is revisiting its decision, and changes to the NFIP are once again being discussed. Central to this debate are four key issues that should be considered in further NFIP reform.

Figure 1 on page 40. At the end of 2012, more than 5.5 million policies were in force, representing almost \$1.3 trillion in coverage. The program is highly concentrated geographically, however, with the state of Florida accounting for roughly 40 percent of the entire NFIP portfolio.

Despite the program's growth, many homeowners in areas of high risk forgo insurance. Possible explanations include budget constraints, lack of understanding of the risk, incorrect perceptions that homeowners policies cover flood damage, lack of enforcement of the mandatory purchase requirement over the life of a loan, and a misperception of the goals of insurance. One possible change to the program that would increase take-up rates is to enroll entire communities instead of households. RFF Resident Scholar Leonard Shabman has explored this idea, and in future work at RFF, we will examine it in more detail. Community enrollment would broaden the policy base and also create a tool to incentivize community-level hazard mitigation.

Two ongoing projects that I am involved in at RFF address the question of whether

Figure 1. Policies and Coverage in the NFIP



postdisaster aid creates a disincentive to insure. Erwann Michel-Kerjan of the Wharton School, Paul Raschky of Monash University, and I are examining whether homeowners decrease insurance coverage or drop policies after receipt of FEMA postdisaster grants or subsidized disaster loans from the Small Business Administration. Other work that Shabman and I have undertaken finds that traditional postdisaster funds for households from FEMA have many restrictions in place to reduce perverse incentives. This does not mean that individuals have all this information, however. Our working hypothesis is that improved information on the limitations of federal postdisaster aid could potentially help individuals make more informed decisions and highlight the benefits of insurance.

Increasing the Financial Security of the Program

The NFIP has always had multiple goals, influencing its pricing strategy. Apart from providing insurance, the program has

sought to promote sound floodplain management, encourage communities to join the program, and encourage households to insure. Historically, a group of policies—those built in a high-risk area before FEMA had mapped the flood hazard—received discounted rates. In the 1980s, the decision was made that the combined revenue from the discounted policyholders and those paying the full premium should cover the average historical loss year. In higher-than-average years, the program was given borrowing authority from the US Treasury.

The problem with this approach is that flooding is a catastrophic risk. Unlike, say, automobile insurance, where claims are fairly constant from year to year, flood claims can deviate dramatically from the mean. Pricing for the average year prevented the program from being able to cover the losses of a catastrophic year, as we saw in 2005.

The legislation that passed in July 2012 phases out these discounts, a decision that should help move the program to sounder financial footing. FEMA actuaries Thomas



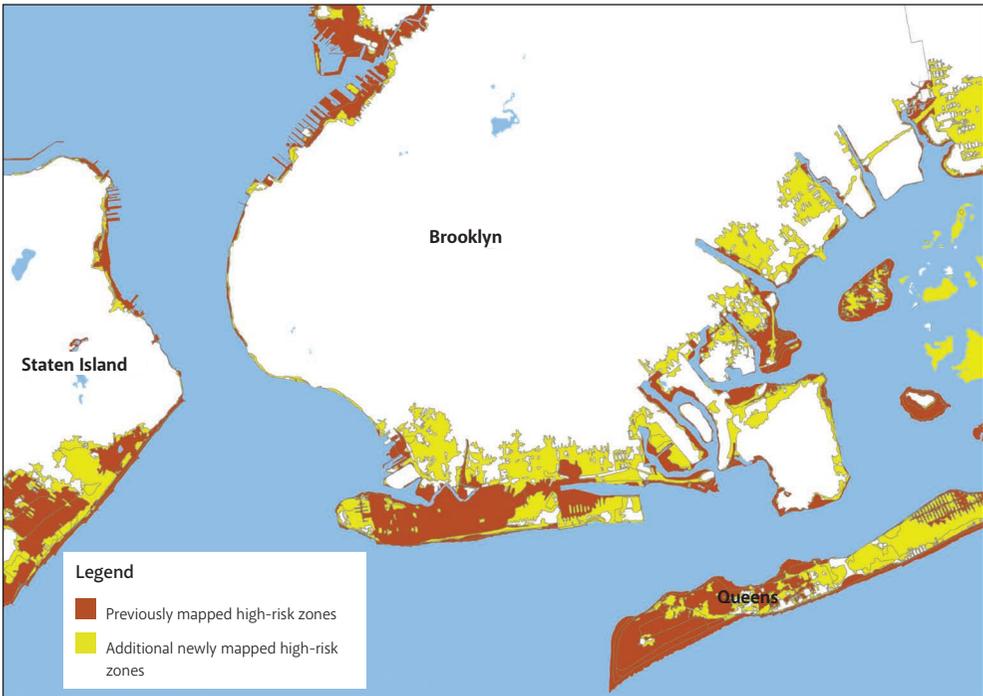
Hayes and Andrew Neal estimate that elimination of the discounts would increase aggregate premium revenue for the NFIP by 50 to 75 percent. The program will need to first begin paying down its massive debt before it is able to use the increased revenue to be better prepared for large loss years. Some observers have argued that given the historic goals and rate structure, the debt may need to be forgiven.

Once the new pricing is fully phased in, the NFIP should consider risk management mechanisms to help it handle catastrophic loss years. One option would be the purchase of private reinsurance (or insurance for insurers). There is some precedent for this in state insurance programs, such as the California Earthquake Authority. The Biggert–Waters bill called for a study of such an option. Another option would be the issuance of catastrophe bonds. More research is needed on how such mechanisms would work and the implications for pricing and risk management in the program.

Providing Up-to-Date Flood Hazard Information

FEMA produces flood hazard maps for communities defining different flood zones. Zones are one determinant of premiums and also inform other regulatory requirements of the NFIP. Yet many maps are outdated, and FEMA has been updating them around the country in order to incorporate more recent data, improved mapping methodologies, and changing conditions. For example, the current maps for coastal New York and New Jersey are more than 25 years old. FEMA was in the process of revising these maps when Hurricane Sandy hit. While not finalized, the maps were released in an advisory capacity to guide rebuilding after Sandy. In June 2013, FEMA updated the advisory maps into so-called preliminary work maps, although they are still not finalized or adopted for rate setting and regulation. These new maps—as in some other places around the country—show increases in high-risk areas. Figure 2 on page 42 shows the newly mapped, high-

Figure 2. High-Risk Areas in New York City



hazard (100-year floodplain) areas for parts of Staten Island, Brooklyn, and Queens.

Accurate risk information is essential for sound investment decisions and appropriate pricing. The long delay between map updates hinders decisionmaking and invites backlash when large changes are imposed on a community abruptly. This has been exacerbated by the Biggert–Waters bill, which eliminates the historical practice of grandfathering rates. Before the bill passed, if a household was newly mapped into a high-hazard area (where insurance is mandatory and rates are higher, commensurate with the higher risk), as long as it maintained its policy, it could be grandfathered at the lower rates of the old zone. Now, when newly mapped into a riskier zone, households must pay the full rate for that zone.

Before the reform bill, the average rates for nondiscounted policies were just over \$400 a year outside of high-risk areas, just over \$500 a year for properties in a 100-

year floodplain but not subject to storm surge, and over \$3,000 a year for those in coastal 100-year floodplains where wave action is possible. The new maps for coastal areas in New York and New Jersey also show advisory base flood elevations, or the height of water estimated for a 100-year flood. The difference between this and the height of one's home influences the premium: lower homes pay higher rates, as they are at greater risk. The new maps show some households below the new base flood elevation estimate, which means even higher premiums, conceivably reaching into the tens of thousands of dollars annually for some homeowners unless they elevate their properties. FEMA is in the process of studying rates for these so-called negatively elevated structures.

The financial implications make the new maps contentious (see next section on affordability). Still, the program must find a way to issue map updates more frequently,

since decades between maps starve communities of important information on changing conditions. Involving the private sector could potentially help generate more frequent updates in hazard information.

Wharton School Professor Howard Kunreuther, is the use of an insurance voucher system, similar to food stamps. Under this scheme, flood insurance premiums would be based on risk levels, providing

The National Flood Insurance Program must find a way to issue map updates more frequently, since decades between maps starve communities of important information on changing conditions.

Another information need is how risks may change in the face of development and climate change projections. Sea-level rise will not only threaten some coastal areas with inundation but also allow storm surge to push farther inland, exposing more areas to coastal flood hazards. Although annual pricing does not require projections decades into the future, development and infrastructure decisions are long-lived and should be informed by projections of changing conditions. The Biggert–Waters legislation has instructed FEMA to investigate the possibility of mapping future conditions. This type of mapping could also provide a way to warn homeowners that their risk zones may change in the future so new designations do not come as a surprise.

Addressing Affordability

As NFIP discounts phase out and new maps expand high-risk areas, some homeowners are finding they are not able to afford flood insurance. The homeowner upset over these price increases has made some politicians seek to reestablish the original discounts in the program or slow down the phase-in of higher rates. But the discounts that were in the program were never based on ability to pay.

One approach to keep low-income residents from being locked out, suggested by

important risk information to those making development and investment decisions. But households with demonstrated need—such as those with incomes below certain levels—would be eligible for vouchers, used only for insurance, to help offset the cost of their policies. We are exploring whether this could be coupled with loans for hazard mitigation to reduce damages and also premiums. Affordability is a critical issue, but discounts should be targeted at low- and moderate-income households and tied to hazard mitigation to make everyone safer.

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A Look at What's Happening

Inside RFF

RFF Resident Scholar **Leonard Shabman** was appointed to the National Research Council Committee on Strategic Research for Integrated Water Resources Management.

RFF Fellow **Rebecca Epanchin-Niell** was selected to be a member of the Council on Food, Agricultural and Resource Economics Blue Ribbon Panel of Experts for Natural Resources and Environmental Issues.

RFF University Fellow **James Sanchirico** received the 2012 Rosenstiel Award from

the University of Miami Rosenstiel School of Marine & Atmospheric Science for his research on the economics and ecology of spatial–dynamic processes in renewable resources management, particularly the design of marine protected areas.

Co-Director of RFF's Center for the Management of Ecological Wealth and Visiting Scholar **Lynn Scarlett** was appointed to the Board of Trustees of the National Parks Conservation Association.

RFF Summer Interns



Each year, interns come from around the world to work with RFF researchers and staff for the summer. Above, RFF President Phil Sharp greets the 2013 summer interns. In the front row (left to right): **Kate Donahue**, Phil Sharp, **Supriya Khadke**, and **Molly Feiden**. In the back row (left to right): **Tabish Baig**, **Brady McCartney**, **Matthew Leisten**, **Lilei Xu**, **Xu Liu**, and **Jonathon Baker**. Not pictured: **Ajita Atreya**, **Stephanie Fried**, **Cuicui Chen**, **Sharon Pailer**, and **Minbo Xu**.

RFF Appoints Three New Board Members

RFF is pleased to announce the appointments of three new members to its Board of Directors.



David Hawkins
*Director, Climate Center,
 Natural Resources
 Defense Council (NRDC)*

David Hawkins joined NRDC as an attorney in 1971 and worked on air pollution issues until 1977, when he

was appointed assistant administrator for air, noise, and radiation at the US Environmental Protection Agency during the Carter administration. He returned to NRDC in 1981 and worked throughout the next decade primarily on reauthorizing the Clean Air Act. Hawkins was the director of NRDC's air and energy program from 1990 to 2001, when he became director of its new climate center.

Hawkins is a recognized expert on advanced coal technologies and carbon capture and storage, and he is working at national and international levels to promote actions to lessen human-induced climate destruction. He has an English degree from Yale College and a law degree from Columbia University. He has served previously on RFF's Board of Directors, from 2002 to 2011.

Bob Litterman
Chairman, Risk Committee, Kepos Capital

Prior to joining Kepos Capital in 2010, Litterman spent a 23-year career at the Goldman Sachs Group, where he served in research, risk management, investments, and thought leadership roles. He oversaw the Quantitative Investment Strategies

Group and Global Investment Strategies, and he became a partner at Goldman Sachs in 1994. Prior to that role, he was co-head of the Fixed Income Research and Model Development Group with Fischer



Black. He is the co-developer of the Black-Litterman Global Asset Allocation Model, a key tool in investment management, and has coauthored books, including *The Practice of Risk Management* and *Modern Investment Management: An Equilibrium Approach*. Litterman has a PhD in economics from the University of Minnesota. He is the inaugural recipient of the S. Donald Sussman Fellowship at the MIT Sloan School of Management and serves on a number of boards, including Commonfund, the Sloan Foundation, and the World Wildlife Fund.

Henry Schacht
*Managing Director and Senior Adviser,
 Warburg Pincus*

Henry Schacht joined Warburg Pincus in 1995. During leaves of absence, he served as chairman and chief executive officer and then again as chairman of Lucent Technologies. Prior to joining Warburg Pincus, Schacht was chairman and chief executive officer of Cummins Engine Company. He is a senior adviser to the Board of Directors of Alcoa and previously served as a director of Alcoa, Alcatel-Lucent, AT&T, Avaya, CBS, Chase



Manhattan, Lucent, the *New York Times*, and Johnson & Johnson. He is a former member of the Business Council and the Business Roundtable. Schacht is a trustee of the Metropolitan Museum of Art, former chair-

man of the Board of Trustees of the Ford Foundation, and a former trustee of Yale University and the Rockefeller Foundation. He graduated from Yale University and has an MBA from Harvard Business School.

RFF Welcomes New Center Fellow Brian Flannery

RFF recently welcomed **Brian Flannery** to its staff as a center fellow in RFF's Center for Climate and Electricity Policy. Flannery is retired from the Exxon Mobil Corporation, where he served as its science, strategy, and programs manager in the Environmental Policy and Planning Department. While at Exxon, he played a leadership role in the creation of the Joint Program on the Science and Policy of Global Change at MIT and the Global Climate and Energy Project at Stanford University.

Currently, Flannery also collaborates with the Joint Global Change Research

Institute and serves as chair of the Business Engagement Task Force of the Major Economies Business Forum and the Green Economies Dialogue project.

He received a PhD in astrophysics from the University of California, Santa Cruz, and pursued research at the Institute for Advanced Study as a professor at Harvard University. He is coauthor of the widely used reference *Numerical Recipes: The Art of Scientific Computing*.



COMMON RESOURCES

Visit RFF's blog, *Common Resources*, where experts provide up-to-date commentary on the latest research, analysis, and debates surrounding environmental and natural resource policy issues—in DC and around the world.

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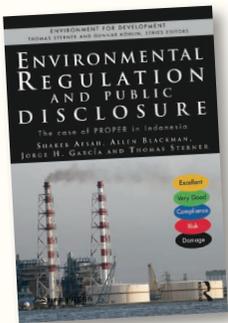


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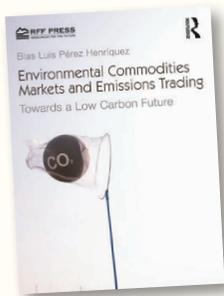
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