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## **Revenue Recycling and the Costs of Reducing Carbon Emissions**

Ian Parry ♦ June 1997

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# REVENUE RECYCLING AND THE COSTS OF REDUCING CARBON EMISSIONS<sup>1</sup>

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## SUMMARY

Taxes on labor and capital income distort economic activity by depressing the overall level of employment and investment in the economy. Imposing regulations to curb emissions of CO<sub>2</sub> in the United States is likely to further reduce the overall level of employment and investment, thereby aggravating the distortions created by taxes. These types of “spillover” effects have been termed the *tax-interaction effect*. Taking into account the tax-interaction effect raises the overall costs of reducing CO<sub>2</sub> emissions, and by a potentially significant amount.

However some policy instruments would raise revenue for the government. These instruments include carbon taxes and CO<sub>2</sub> permits that are auctioned to firms. The revenue can be used to cut other distorting taxes, such as social security taxes and corporate income taxes. Reducing these taxes increases the level of employment and investment, and thereby produces an economic gain. This gain has been termed the *revenue-recycling effect*. The gain from the revenue-recycling effect can offset most, but typically not all, of the added cost from the tax-interaction effect.

Other policy instruments to reduce emissions, such as tradable CO<sub>2</sub> permits where the permits are given out free to existing firms, would not raise revenues for the government. These instruments do not produce the revenue-recycling effect to counteract the tax-interaction effect, and therefore have a higher economic cost than revenue-raising instruments. This distinction between revenue-raising and non-revenue-raising policies can affect whether a policy might produce an overall net gain for society or not. That is, for a given level of emissions reduction the environmental benefits under a revenue-raising instrument may exceed the economic costs, while under a non-revenue-raising instrument benefits may fall short of economic costs.

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## INTRODUCTION

The continued accumulation of heat-trapping gases in the atmosphere raises the prospect of future global warming and other associated changes in climate. Carbon dioxide (CO<sub>2</sub>) is the most important example of these gases. Man-made emissions of CO<sub>2</sub> are primarily caused by the burning of fossil fuels, which all contain carbon. An international conference is being held this December in Kyoto, Japan, to consider steps for reducing emissions of CO<sub>2</sub>.

The benefits from reducing CO<sub>2</sub> emissions are very difficult to assess. Enormous uncertainties surround the extent, global distribution and economic impacts of possible changes in climate. Global warming may turn out to be a very serious problem, or it may not. Despite these uncertainties, economists such as William Nordhaus of Yale University have cautioned against drastic measures to control CO<sub>2</sub> emissions at this time. Others have expressed greater concern.

Whatever emissions targets might be agreed to in Kyoto, it is crucial to understand the economic costs that will be incurred in achieving these targets. In particular, it is important to use policy instruments that minimize the economic costs associated with a given amount of emissions reduction. Economic research suggests that much will be at stake in this respect: Even the costs of modest reductions in CO<sub>2</sub> emissions may differ substantially under different types of regulatory policies. Traditionally, economists have argued that the costs of reducing emissions are significantly lower under “incentive-based” policy instruments – such as emissions taxes and tradable emissions permits – than under more direct regulations, such as those forcing all firms to adopt the same pollution abatement technologies.

More recent research has emphasized the difference between policy instruments for controlling CO<sub>2</sub> emissions that raise revenues for the government and those that do not raise revenues. Revenue-raising instruments include taxes on the carbon content of fossil fuels, and tradable CO<sub>2</sub> permits where the permits are sold or auctioned by a regulatory agency. Non-revenue-raising instruments include performance standards (emissions limits) and tradable carbon permits when the permits are given out freely to firms.

This research has focused on the interactions between proposed carbon abatement policies and the tax system. Taxes distort economic behavior. Taxes on labor income reduce the overall level of employment in the economy. To the extent that employers must pay more for labor – because they have to pay social security taxes or because employees demand higher wages to compensate for taxes – the demand for labor will be lower. Also, to the extent that taxes reduce the effective take-home pay of employees, they reduce the supply of labor. For example, the partner of a working spouse may be discouraged from joining the labor force, an older worker may retire earlier, or a worker with one job may be discouraged from working additional hours in a second job. Taxes on the income from capital reduce the overall level of investment and savings in the economy and encourage current consumption. These taxes include income and capital gains taxes that individuals pay on the income from savings. They

also include taxes that corporations must pay on the income earned from expanding the size of their operations by investment.

Similarly, regulations that increase the costs to firms of producing output also tend to reduce the level of employment and investment in the economy, and thereby add to the distortions created by the tax system. The costs of these spillover effects in labor and capital markets, caused by regulatory policies, have been termed the *tax-interaction effect*. For example, a tax on the carbon content of fossil fuels drives up the cost to firms of producing electricity and gasoline, which tends to reduce the overall level of employment in the economy. In addition, this tax on fossil fuels reduces the incentives for capacity-enhancing investments in these industries. Alternative policies to reduce carbon emissions, such as tradable CO<sub>2</sub> permits, have the same impacts on fossil fuel industries, and similar impacts on the overall level of employment and investment in the economy. Indeed these types of regulations can be thought of as “implicit taxes,” since they raise the costs to firms of producing output in the same way that an explicit tax on the firm’s activities would.

Taking into account the tax-interaction effect raises the overall costs of regulations, and possibly by a substantial amount. This has been demonstrated in recent collaborative work by Lawrence Goulder, Roberton Williams (both at Stanford University) and myself (at Resources for the Future). For example, we estimate that the economic costs to the United States of using freely issued tradable permits to reduce CO<sub>2</sub> emissions by 10 percent below current levels is 5 times greater, when interactions with the tax system are taken into account.

These findings are very troubling. However, the results from the recent research are not all bad. Some types of regulatory policies can raise revenues for the government. These policies include taxes on the carbon content of fossil fuels and tradable CO<sub>2</sub> permits when these permits are sold by the government rather than given out freely to firms. Significant economic gains are to be had from using these revenues to reduce other taxes that distort the level of employment and investment. Indeed most of the cost from the tax-interaction effect may be offset by this so-called *revenue-recycling effect*. Thus our research suggests that the overall costs of reducing CO<sub>2</sub> emissions would be much lower under a policy that raised revenues – and used these revenues to cut other taxes – than under a policy that did not raise revenues.

Recently, considerable confusion has arisen about the implications of tax distortions in the economy, with regard to the costs of carbon abatement policies. In particular, a number of analysts have mistakenly argued that there would be a “double dividend” from carbon taxes. They have – correctly – pointed to the potential benefits from recycling carbon tax revenues in other tax reductions. They have failed, however, to recognize the adverse impact on employment and investment when the tax is initially imposed (prior to revenue recycling). The rest of this paper elaborates on the misperceptions behind the double dividend hypothesis, and on other issues related to the interaction between CO<sub>2</sub> regulation and the tax system.

## THE RISE AND FALL OF THE DOUBLE DIVIDEND HYPOTHESIS

Lawrence Goulder has identified several different notions of the double dividend hypothesis. My preferred definition is the hypothesis that environmental taxes can reduce pollution and reduce the overall economic costs associated with the tax system at the same time. At first glance, this hypothesis seems to be self-evident, if the revenues raised are used to reduce other taxes that discourage work effort and investment. In some European countries, where high taxes, among other factors, have contributed to double-digit unemployment rates, the double dividend hypothesis has been particularly appealing. It was thought that environmental taxes could be used to reduce both unemployment and pollution. More generally, it was argued that it is better to finance government spending by taxing economic “bads,” such as pollution, rather than economic “goods,” such as employment and investment.

Indeed a stronger form of the double dividend hypothesis asserts that a carbon tax can produce net economic gains for society, in addition to the benefits from reduced pollution emissions. It has been argued that this would occur if the benefit from the revenue-recycling effect outweighed the costs imposed on industries affected by an environmental tax. This notion is very appealing because the benefits from emissions reduction – particularly in the case of CO<sub>2</sub> emissions – are often very difficult to quantify. If the strong double dividend were possible, introducing a carbon tax could produce a net gain for society, even if the benefits from reducing CO<sub>2</sub> emissions turned out to be very modest.

General agreement exists among economists that revenue recycling per se does reduce the net cost of a carbon tax, and therefore a weak notion of the double dividend hypothesis is valid. However, recent analysis suggests that the overall impact of a carbon tax is most likely to *increase* rather than *decrease* the costs associated with the tax system. Pre-existing distortions created by the tax system *raise*, rather than lower, the overall costs involved.

The crucial flaw in the double dividend hypothesis is that it ignores the tax-interaction effect. Environmental taxes tend to reduce employment and investment (prior to recycling the revenues), thereby adding to the distortions created by the tax system. This is because they raise the costs to firms of producing output. For example a tax levied on fossil fuels would increase the costs of purchasing energy. Lans Bovenberg of Tilburg University, Lawrence Goulder, and others have demonstrated that these adverse employment and investment effects are not fully offset by using the environmental tax revenues to reduce other taxes, such as taxes on personal and corporate income. That is, the tax-interaction effect *dominates* the revenue-recycling effect, and the net impact of environmental taxes typically is to reduce the level of employment and investment in the economy. As usual in economics, closer inspection reveals that there are no free lunches.

Indeed because environmental taxes have a relatively narrow base, we would expect them to be more distortionary than a broader-based tax such as the personal income tax. The base of a tax refers to the range of productive activities that the tax is levied on. The narrower the base, the greater the scope for firms and consumers to substitute away from the tax by

reducing employment, increasing spending on other goods, and so on, and hence the greater the distortion created by the tax.

A tax on the carbon content of fossil fuels penalizes those industries that use fossil fuels intensively, in particular the electricity and transportation industries. This leads to two types of distortion (ignoring investment impacts). First, the overall level of employment tends to fall as these industries contract. Second, the tax causes a shift in consumer spending away from goods produced by these industries – whose prices are driven up – toward other goods such as food, clothes, and entertainment, whose prices are not affected as much. In contrast, broad-based taxes, such as individual taxes on take-home pay, only create one type of distortion. These taxes do discourage employment, but they do not affect relative consumer prices and hence the pattern of consumer spending across different goods. The environmental tax policy discussed above effectively replaces revenues raised from broad-based taxes by revenues from a narrow-based tax. Tax economists have long recognized that this type of policy change will increase the overall costs of the tax system, because it introduces a distortion in consumer choices amongst different goods.

It should be emphasized that the above discussion is only concerned with the *economic costs* of a carbon tax. A consequence of a carbon tax would be to shift spending away from activities that produce carbon emissions and into other activities. This is exactly what is desired from an environmental perspective. If the environmental benefits from reducing carbon emissions exceeded the overall economic costs of the carbon tax, then society would be better off with the tax.

### **CAN THERE EVER BE A DOUBLE DIVIDEND?**

The answer to this question would be no, if the tax system were fully efficient. That is, if the composition of the tax system could not be changed so as to reduce the economic costs of the tax system for a given amount of revenue raised. In practice, tax systems are full of inefficiencies, and this revives the possibility of a double dividend from environmental taxes under special circumstances.

The most important source of inefficiency is thought to arise from capital being “overtaxed” relative to labor. Therefore, if the overall effect of an environmental tax is to shift the tax burden away from capital and onto labor, the costs of the tax system will be reduced and a double dividend may result. This prospect is more likely if the environmental tax revenues are used to cut taxes on capital (such as the corporate income tax) and if the industries affected by the environmental tax are relatively labor-intensive.

Presumably, however, shifting the burden of taxation away from capital is something the government could do directly. Why “disguise” such a shift by using an environmental tax? A possible reason is that direct tax reform can be politically difficult. For example, a cut in the rate of corporate income tax is perceived as benefiting higher income groups. This

consequence is less transparent, and hence perhaps the tax shift is easier to obtain, if brought about by an environmental tax swap.

## **ALTERNATIVE MEANS OF RECYCLING CARBON TAX REVENUES**

Are there other ways that carbon tax revenues might be recycled to reap economic benefits besides cutting taxes? Yes, if the revenues were used to reduce the federal budget deficit. This would mean that less tax revenues in the future would be required for interest payments and repayment of principal on the national debt. As a result, the distortion in the level of employment and investment caused by future taxes would be lower. Thus, using environmental tax revenues for deficit reduction can also produce a revenue-recycling benefit for society, although this economic gain occurs in the future rather than the present.

The answer is “it depends”, if the revenues were used to finance additional public spending. The huge bulk of government expenditure in the United States consists of transfer payments, such as pensions, or expenditures that could mostly be provided by the private sector, such as medical care and education. Loosely speaking (and ignoring distributional impacts) the benefit to people from a billion dollars of this type of spending is a billion dollars. Suppose instead that the billion dollars was returned to the private sector by reducing taxes, say the personal income tax. In this case the benefits exceed a billion dollars. Not only do people get a billion dollars, but also the lower tax rates will favorably alter relative prices in the economy. The rewards for working as opposed to not working, and saving as opposed to consuming, are increased, thereby encouraging more employment and investment. In contrast the increased public spending does not alter relative prices. This means that the benefits from a billion dollars in additional public spending are generally less than those from a billion dollars of tax cuts.

But another component of government expenditure is on what economists call “public goods”. These are goods that, for various reasons, may not be provided by the private sector such as defense, crime prevention and aid to needy families. People may (or may not) value a billion dollars of additional spending on these types of goods at more than a billion dollars. If so, the economic benefits of a billion dollars from this type of revenue recycling may be as large (or even larger) than the benefits of a billion dollars in tax reductions.

## **CARBON TAXES VERSUS CO<sub>2</sub> PERMITS**

An alternative way to reduce CO<sub>2</sub> emissions is to require that firms have a permit for each unit of emissions that they produce. By controlling the total quantity of permits available to firms, a regulatory agency can limit total CO<sub>2</sub> emissions to a given target level. Allowing firms to trade these permits among themselves affords a lot of flexibility in achieving emissions reductions. For example, firms for whom it would be very costly to reduce emissions can purchase permits from firms that can reduce emissions at relatively low cost. The same flexibility is achieved under an emissions tax, since firms can choose to pay more taxes rather than reduce emissions. For this reason, economists have traditionally favored tradable emissions permits and emissions taxes over a more direct “command and control” type of regulation that might require all firms to reduce emissions by the same amount.

A regulatory agency could either auction off CO<sub>2</sub> permits, or give them out free to existing firms. In the former case, the policy is essentially equivalent to a carbon tax (for a given amount of emissions reduction). This is because the policy raises revenues for the government that can be used to reduce other taxes in the economy. In the latter case, no revenue-recycling effect occurs, since no revenues are raised for the government. However, the policy produces the same tax-interaction effect, as would a carbon tax that produced the same reduction in emissions. This is because it causes the same contraction in the industries that use fossil fuels.

Since a free CO<sub>2</sub> permits policy would not produce the revenue-recycling effect, it would be more costly than a carbon tax or a policy where the permits were auctioned (though it may still be more cost-effective than command and control policies). Our estimates suggest that the difference can be striking. For example, we estimate that the overall economic cost to the United States of a 10 percent reduction in CO<sub>2</sub> emissions below current levels would be 300 percent greater under free CO<sub>2</sub> permits than if a carbon tax were imposed. The reason for this result is that the tax-interaction and revenue-recycling effects are large compared with the economic costs of the regulation in the affected industries.

Indeed we estimate that the economic costs of a non-auctioned CO<sub>2</sub> permit program for the United States will exceed the environmental benefits – unless the benefits from reducing carbon emissions are above \$25 per ton. Estimates of these benefits by Nordhaus tend to be below \$25 per ton, except under more extreme scenarios for climate change. In contrast, we estimate that a policy to reduce U.S. CO<sub>2</sub> emissions that produces the revenue-recycling effect can induce a net gain, so long as environmental benefits per ton are positive.

It is important to emphasize that the benefit estimates obtained by Nordhaus and others are preliminary and highly speculative at this stage. For example, they do not take into account the possibility of drastic changes in climate, should warming disturb some unstable mechanism within the climate system. Nor do they take into account possibly adverse impacts on the distribution of world income arising from the greater vulnerability of poorer countries to climate change.



Moreover, there are other factors to consider in choosing among policy instruments besides whether they raise revenue or not. For example, the affected industries might be less opposed to non-auctioned emissions permits than to an emissions tax, since, in the former case, they would retain the rents from the policy. Other considerations might include the potential impact of a given instrument on private incentives to develop energy-saving technologies.

## **CONCLUSION**

To sum up, carbon abatement policies are likely to add to the distortions in the economy created by the tax system. Taking into account this effect raises the overall economic cost of reducing emissions, and by a potentially substantial amount. However, much of this added cost can be offset if the policy raises revenue for the government, and these revenues are used to cut other taxes. Thus, a potentially important distinction exists between revenue-raising policies, such as carbon taxes, and non-revenue-raising policies, such as (non-auctioned) tradable CO<sub>2</sub> permits.

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## **FURTHER READING**

Estimates of the costs from carbon abatement policies, taking into account interactions with the tax system, are contained in Ian Parry, Robertson Williams and Lawrence Goulder, "When Can Carbon Abatement Policies Increase Welfare? The Fundamental Role of Distorted Factor Markets," RFF discussion paper # 97-18 (at RFF's web site: [www.rff.org](http://www.rff.org)).

For a good survey of the literature on the double dividend hypothesis, see Wallace Oates, "Green Taxes: Can We Protect the Environment and Improve the Tax System at the Same Time?," *Southern Economic Journal*, **61**, (1995), and Lawrence Goulder, "Environmental Taxation and the Double Dividend: A Reader's Guide," *International Tax and Public Finance*, **2** (1995).

More technical discussions of the interactions between environmental taxes and the tax system can be found in: Lans Bovenberg and Ruud de Mooij, "Environmental Levies and Distortionary Taxation," *American Economic Review*, **84**, (1994); Lans Bovenberg and Lawrence Goulder, "Optimal Environmental Taxation in the Presence of other Taxes: An Applied General Equilibrium Analysis," *American Economic Review*, **86**, (1996); and Ian Parry, "Pollution Taxes and Revenue Recycling," *Journal of Environmental Economics and Management*, **29** (1995).

## **About RFF**

Resources for the Future (RFF) is an independent, nonprofit research organization that aims to help people make better decisions about the conservation and use of their natural resources and the environment. For the past 45 years, researchers at RFF have conducted environmental economics research and policy analysis involving such issues as forests, water, energy, minerals, transportation, sustainable development, and air pollution. They also have examined, from a variety of perspectives, such topics as government regulation, risk, ecosystems and biodiversity, climate, hazardous waste management, technology, and outer space.

While many RFF staff members are economists by training, other researchers hold advanced degrees in ecology, city and regional planning, engineering, American government, and public policy and management. RFF neither lobbies nor takes positions on specific legislative or regulatory proposals. Its operating budget is derived in approximately equal amounts from three sources: investment income from a reserve fund; government grants; and contributions from corporations, foundations, and individuals (corporate support cannot be earmarked for specific research projects). Some 45 percent of RFF's total funding is unrestricted.

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## **About RFF's Climate Issues Briefs**

As decisionmakers prepare for domestic policy debates and the ongoing international negotiations under the Framework Convention on Climate Change, RFF's climate issues briefs provide topical, timely, and non-technical information and analysis. They are intended to integrate the various aspects of climate change with critical reviews of existing literature and original research at RFF on climate policy, energy markets, water and forest resource management, technological change, air pollution, and sustainable development.

Forthcoming briefs will examine issues related to domestic emissions trading programs; the scheduling of emissions reductions over time; the potential for technical innovation to substantially lower the cost of limiting greenhouse gases; and different modeling approaches for assessing the economic costs of limiting emissions of greenhouse gases.

## **About RFF's Climate Economics and Policy Program**

As international debate intensifies over possible agreements to limit emissions of greenhouse gases, Resources for the Future (RFF) launched its Climate Economics and Policy Program in October 1996 to increase understanding and knowledge of the complex issues that must be addressed to design appropriate domestic and international policies that are effective, reliable, and cost-efficient. The program responds to both the long-term debate about climate change, and the specific debates surrounding the negotiations being carried out under the United Nations Framework Convention on Climate Change.

The publication of the Second Assessment Report of the Intergovernmental Panel on Climate Change signaled the beginning of a broader agenda of research and debate on global climate change. While there is still scientific uncertainty about the magnitude of climate change risks, the world's policy makers are now shifting more of their attention to debating appropriate policy responses.

RFF brings a well recognized and respected reputation for objectivity to this debate. The Climate Economics and Policy Program integrates the many different aspects of climate change with ongoing basic and applied research at RFF involving energy markets, water and forest resource management, air pollution, environmental regulation, and sustainable development.

**PROGRAM AREAS.** Drawing on RFF's strengths in environmental and natural resource assessment, economic analysis, and policy design, the climate program focuses on five main areas:

- Economic and environmental consequences of climate change and policies to deal with climate change.
- Domestic and international policy design issues.
- Interactions between climate change and other policies.
- Equity, efficiency, and other criteria used in decisionmaking.
- Development of analytical tools.

**PROGRAM OUTPUTS.** RFF's climate program includes original basic and applied research, policy analysis, and educational outreach.

**Research.** Integrating basic and applied research on the economic implications of global climate change with ecological, engineering, scientific, environmental health, geographical, international, and other considerations, an initial set of research projects underway at RFF include:

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

***Policy analysis.*** As a response to questions arising in the ongoing international negotiations, RFF will issue a series of short papers on a variety of issues related to policy in 1997. These studies will be based on original research combined with critical reviews of existing literature. Potential questions to be addressed include:

- How should the climate problem be thought about in general?
- How might a domestic emissions trading program be established?
- How does the performance of revenue-raising and non-revenue-raising policy instruments compare?
- How should emissions reductions be scheduled over time?
- What is the potential for technical innovation to substantially lower the cost of greenhouse gas limitations, and what government policies can tap that potential?
- What are the strengths and weaknesses of different modeling approaches for assessing the economic costs of greenhouse gas limitations?

***Educational outreach.*** RFF regularly shares its climate change findings with members of the academic, business and environmental communities, and representatives of local, national and international governments by publishing and disseminating discussion papers and convening educational forums on selected topics. To support a well-informed public, RFF provides regular reports of its climate change activities to the news media, posts program updates and activities on RFF's internet home page (<http://www.rff.org>), and will provide educational materials for lay audiences on the economics of climate change.

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# Looking for an honest broker for climate change policy?

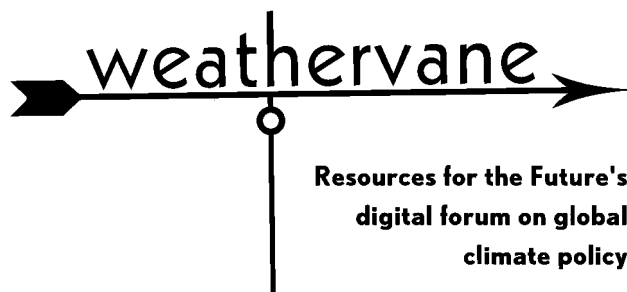
In light of the continuing international negotiations over climate change, Resources for the Future (RFF) publishes *Weathervane*, an internet forum dedicated to climate change policy. Just as a traditional weathervane tracks the direction of the wind, *Weathervane* has been tracking developments in climate change policy, both internationally and within the United States, since July 1997.



Our editorial aim is to present balanced and objective information, with no one perspective or viewpoint dominating our analysis and reporting. Now with an eye on the Fourth Conference of Parties, to be held in Buenos Aires, Argentina in November 1998, and the stakes potentially enormous on all sides of this complicated issue, *Weathervane* continues to provide a neutral forum for careful analysis to complement the political calculations that so often drive decisions.

Regular site features include:

*Perspectives on Policy*, an opinion forum for invited players in the climate policy debate. It gives experts from every corner — business, government, environmental groups, and academia — an opportunity to weigh in with their opinions on a selected topic; *By The Numbers*, a regular column by RFF's Raymond Kopp to help decode and demystify energy and environmental data and create a better understanding of the link between economic data and policy formulation; *Enroute to Buenos Aires*, which tracks developments in global climate change policy and players in the debate; *Research Spotlight*, which reports new climate findings and projects; and *Sounding Off*, an open forum for site visitors to voice their opinions on a variety of topics related to climate change.



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