FAIR AND LOW-COST CLIMATE PROTECTION

BACKGROUNDER NO. 1—SEPTEMBER 1999

INTRODUCTION

In 1997, Congress and the Clinton administration gave broadcasters up to $70 billion worth of public airwaves to use for digital television. Politicians are ready to give away another public resource at taxpayers' expense, only this time the stakes are much higher—as much as $300 billion every year. What do they want to give away this time? The rights to pollute the atmosphere with the greenhouse gases that cause global warming. The impact of this giveaway goes beyond the free use of a public resource by private interests. Giving away the rights to pollute will affect whether or not the United States achieves fair and low-cost climate protection.

Politicians and the public increasingly recognize what most scientists have been contending for years: human actions are impacting the global climate. Record temperatures, floods, and the spread of disease are just some of the possible repercussions. The Clinton administration, presidential candidate George W. Bush, and many members of Congress have all stated that climate change is a problem. Each should be committed to acting in a way that is in the best interests of all Americans.

Redefining Progress strongly believes that the United States should not give away rights to pollute the atmosphere; polluters should be required to pay for their greenhouse gas emissions through either auctioned emissions permits or pollution taxes.[1] Our campaign will seek to convince policymakers in Congress and the White House that charging polluters for their greenhouse gas emissions rather than giving away rights to pollute improves:[2]

• **Economic Well-Being.** Over 2,500 economists, eight Nobel Prize winners among them, have stated that the United States can most efficiently implement climate policies through market-based mechanisms, such as carbon taxes or the auction of emissions permits. The revenue generated from such policies can be used to reduce the deficit or to lower existing taxes *(see box 1)*.

• **Social Equity.** Giving away pollution rights would amount to one of the largest corporate giveaways ever. Some businesses could receive billions in windfall profits from free permits, while other businesses, consumers, workers, and citizens receive nothing. The alternative—pollution charges—would create a level playing field among businesses and a revenue source that could be used to help workers, communities, businesses, and consumers that are hurt financially by price increases resulting from emissions reductions.

• **Environmental Protection.** Droughts, floods, sea level rise, and the spread of disease are only a few of the predicted results of global warming. A broader base of support increases the likelihood of the adoption of policies to reduce the risk of climate change sooner rather than later. Giving away pollution rights only benefits firms who receive them. In contrast, policy options that raise revenue that is then returned to the economy benefit a much broader array of businesses, workers, and consumers, thus building a larger constituency for action to slow global warming. In addition to building a broader constituency, pollution charges speed the widespread adoption of clean-energy technologies, one of the most important pathways to reducing human-caused climate change. Although permit giveaways, auctioned permits, and taxes would create similar incentives for technological innovation, auctioned permits and taxes would create better incentives for the widespread dissemination of low-carbon technology throughout the economy.

BOX 1: ECONOMISTS' STATEMENT ON CLIMATE CHANGE

Endorsed by over 2500 Economists Including Eight Nobel Laureates

I. The review, conducted by a distinguished international panel of scientists under the auspices of the Intergovernmental Panel on Climate Change, has determined that "the balance of evidence suggests a discernible human influence on global climate." As economists, we believe that global climate change carries with it significant environmental, economic, social, and geopolitical risks, and that preventive steps are justified.

II. Economic studies have found that there are many potential policies to reduce greenhouse-gas emissions for which the total benefits outweigh the total costs. For the United States in particular, sound economic analysis shows that there are policy options that would slow climate change without harming American living standards, and these measures may in fact improve U.S. productivity in the longer run.

III. The most efficient approach to slowing climate change is through market-based policies. In order for the world to achieve its climatic objectives at minimum cost, a cooperative approach among nations is required—such as an international emissions trading agreement. The United States and other nations can most efficiently implement their climate policies through market mechanisms, such as carbon taxes or the auction of emissions permits. The revenues generated from such policies can effectively be used to reduce the deficit or to lower existing taxes.

Policymakers appear likely to pursue a *tradable emissions permit system* to limit greenhouse gas emissions *(see box 2).* The Clinton administration, private industry, many members of Congress, and a number of NGOs support that approach. In fact, President Clinton's Climate Change Proposal states, "The President is committed to a market-based emissions trading system, both domestically and internationally, that will harness the power of the market to reduce emissions." Under this approach policymakers have a choice: give away the rights by handing out free permits or charge polluters for their greenhouse gas emissions, either through auctioned permits or pollution taxes.

Any policy that substantially limits carbon emissions will necessarily cause fossil-fuel prices to rise. The extra money generated by the price increase then flows to those companies selling products whose prices have risen. But why should the buck stop there? If the government gives away pollution rights, the extra money consumers and most businesses will pay stays in the pocket of the select few corporations that were granted free pollution rights, which would be unfair and hurt working families, most businesses, and the economy. Exceptions, of course, exist. One free distribution scheme (permit allocation based on a firm's output of products or services) has been proposed that can avoid windfall profits and large price effects, but it lacks some of the additional benefits offered by pollution charges.[3]

Instead, it would be more direct and simple to charge polluters for their carbon emissions, then return the revenue to citizens and businesses through tax cuts or rebates. For example, one proposal for early action would stabilize greenhouse gas emissions in 2002 at 1990 levels, which could yield over $33 billion annually from pollution charges.[4] The revenue could then cut existing payroll taxes, giving workers an extra $285 per

year; increase funding for health care or education; reduce the deficit; or just give every citizen $120 rebate every year, thus offsetting most, if not all, of a household's energy price increase.

Extremely pessimistic economic studies, which many believe contain highly unrealistic assumptions, estimated that emissions permit prices would be very high, raising about $300 billion each year by 2010 (WEFA 1998). If returned as a lump-sum rebate, each citizen would receive slightly more than $1,000 per year.[5] Fortunately, the higher the estimated cost to the economy, the more revenue would be raised to offset higher energy prices. In the long term, the economy will widely adopt clean-energy technologies, thus driving energy prices back down; revenues will decrease, as will the need for revenues to offset price increases.

In addition to returning the revenue to the economy, some revenue should also be used to compensate displaced workers and firms in energy-intensive industries, such as coal mining, and protect low-income consumers who may be temporarily harmed by price increases resulting from greenhouse gas reductions. The revenue could easily take care of the most vulnerable industries, workers, and consumers while leaving plenty to distribute more widely through rebates or tax reductions.

BOX 2: HOW A TRADABLE EMISSIONS SYSTEM WORKS

When the government requires polluters to hold pollution permits, then allows the permits to be bought and sold, it is called a tradable emissions permit system. A tradable emissions permit system operates by first limiting the total amount of pollution that may be emitted from all sources. Emitters are then free to decide how they reduce their emissions to stay within this limit. The pollution permits can be used, traded, bought, or sold, thus giving emitters the flexibility and incentive to reduce emissions below their limit and either profit from the sale of the unused permits or save money by buying fewer permits.

Firms are encouraged to emit less than their allotted amount in order to own an emission credit. Firms may then keep the credit for later, or sell it to another firm. Further, if the permits are auctioned, then the firms will need to buy fewer permits in following auctions, thus saving money. This description is a simplification as there are variants of emissions trading systems, but these are its typical components.

In the specific case of greenhouse gases, polluters would be required to hold permits that add up to no more than the total limit on emissions. Most proponents of auctions advocate an "upstream" allocation system, where carbon-emitting fuels are permitted at the source. In an upstream system, oil refineries, natural gas sellers, natural gas pipelines, and coal processing plants would be permitted, totaling about 1,700 permit buyers, meaning that the system would be administratively feasible (Cramton and Kerr 1999). In 1997, the United States negotiated the Kyoto Protocol, along with 160 other countries, under which it agreed to reduce its greenhouse gas emissions by 7 percent between 2008 and 2012. This means that by 2010, the United States can emit about 1.15 billion tons of CO_2 from energy use (Wolff and Sethi forthcoming). Under a tradable emissions permit system, periodically, perhaps quarterly or yearly, permits would be issued to pollution sources that would emit no greater than 1.15 billion tons per year.

CREATING A MARKET FOR PUBLICLY OWNED GOODS

We buy and sell millions of goods and services each day, from the coffee brewed in the morning to the groceries bought in the evening. All of these are privately owned goods and services, and thus are easily bought and sold. However, there is no market for publicly owned goods such as clean air or the airwaves used to transmit television, even though there is a great demand for them *(see table 1)*. The government then often intervenes to allocate and monitor the use of these publicly owned goods to ensure that they are used responsibly.

Creating a market for publicly owned goods, such as use of the atmosphere, can capture the positive qualities of a market system: competition and flexibility. The combination of competition and flexibility spurs innovation, as companies seek to lower their costs, thereby reducing the overall costs to the economy of slowing global warming. We all benefit when firms compete to reduce emissions at the least cost because we get a cleaner environment, with lower price increases for the products these firms make. Box 3 describes the cost savings realized by the acid rain trading program relative to a command-and-control regulatory system. One of the most difficult aspects of creating a market for a publicly owned good is deciding how to allocate it. Rights to use these publicly owned goods may be freely allocated to private users (termed "grandfathering" when the giveaway is based on a firm's past usage); auctioned, just as the government sells Treasury bills; or allocated using a combination of auctions and giveaways.

Taxpayer, environmental, fiscal responsibility, and consumer rights groups, along with economists and policymakers on the right and the left of the political spectrum, argue that private interests should pay for their use of these publicly owned resources.[6] More specifically, many economists contend that auctioning greenhouse gas permits or taxing pollution is the most economically efficient means of slowing global warming *(see box 1)*.

Why then have many publicly owned goods been freely distributed? *(See table 1.)* And why do some policymakers and businesses currently support giving away greenhouse gas permits free of charge? Giveaways are most often defended on the grounds of political expediency as regulated industries are often politically powerful (Petsonk et al. 1998; H. John Heinz III Center 1998). Giving the permits away for free, some argue, can reduce industry opposition to reducing emissions.

In the case of greenhouse gas emissions, however, the stakes are simply too high to allow private interests to grab something that belongs to all of us. Further, not

TABLE 1: TRADING SYSTEMS FOR PUBLICLY OWNED GOODS

Program	Commodity sold	Publicly owned good	Allocation	Goal
Sulfur Dioxide Allowance Program	Tons of sulfur dioxide emissions	Clean air	Free	Acid rain reduction
U.S. Montreal Protocol implementation	Chlorofluoro-carbons	Ozone layer	Free, based on the companies' market share[7]	Stop destruction of the ozone layer
Broadcast spectrum	Use of airwaves for transmitting television and radio	Airwaves	Free	Cost-effective and fair allocation of the broadcast spectrum
Radio spectrum for personal communication services	Use of the spectrum for portable phones, pagers, and other wireless services	Airwaves	Auctioned, for a total $617 million (Cramton 1995)	Cost-effective and fair allocation of the use of the radio spectrum

all businesses will benefit, only those few receiving free permits. A broader business constituency would be better served by using the revenue raised from pollution charges to reduce corporate taxes or provide direct assistance to energy-dependent businesses.

WHY CHARGING POLLUTERS IS BETTER THAN GIVING AWAY POLLUTION RIGHTS

Redefining Progress believes it is imperative that the valuable right to use the atmosphere be sold rather than given away because charging polluters balances economic well-being, social equity, and environmental protection.[8]

Economic Well-Being

Using market-based mechanisms that rely on pollution charges, such as taxes or auctioning emissions permits, reduces the total cost of limiting greenhouse gases by creating incentives to reduce pollution, yet flexibility in how to do it. Returning the revenue raised through such policies, by lowering taxes or directly rebating the money, would reduce the impact of higher energy prices on the economy. Finally, charging polluters would avoid expensive political battles that would result from firms' fighting to receive the maximum amount of free permits.

What is the most economically efficient option for reducing greenhouse gas emissions?

As the Economists' Statement in box 1 asserts, charging polluters, using either taxes or auctions, is the most efficient way to curb global warming. This conclusion is common and noncontroversial in the economics literature. The revenue can then be returned to the economy through tax reductions or rebates. The combination of charging polluters and then returning the revenue to the economy is a cost-effective policy option for reducing greenhouse gases, because pollution charges generate a new revenue source to offset energy price increases. In contrast, free pollution rights raise no new revenue to offset price increases.

Restricting greenhouse gas emissions will cause some prices to rise in the short term. Adding these price increases to existing income and gas taxes can make slowing global warming more burdensome to low- and middle-income consumers and workers. If these preexisting taxes are not decreased, or the price not offset by returning some of the revenue directly to consumers or businesses, then the overall costs of reducing greenhouse gases can increase significantly (Parry et al. 1996).

Tax reductions or direct rebates are two of the most commonly noted options for returning the revenue to the economy, although other options are possible. For example, we could alleviate some taxes, such as those on food, labor, and savings, and replace them with tax revenue from pollution charges (Hamond et al. 1997). Yet another proposal, the Sky Trust, recommends creating an independent trust that collects revenue by auctioning emissions permits. The trust would then issue equal dividends annually to each and every American—man, woman, and child—based on the amount of revenue generated by the auction.[9]

Wouldn't it be quicker and easier to give away greenhouse gas emissions permits?

No, because pollution taxes or auctioned permits would avoid expensive legal and political battles. Auctioning allowances or taxing polluters would cost less than the government's undertaking a contentious political process in order to decide who should receive how many free allowances. If the government decides who gets what, then industries will lobby furiously and wage public relations campaigns to fight for the maximum number of these valuable permits. Interestingly, this type of high-cost jockeying led to industry *support* for recent radio spectrum auctions for personal communication devices *(see table 1)*. Also, special-interest lobbying resulted in various formulas and allowances that added about $1.4 million to the implementation costs of the Sulfur Dioxide Allowance Program (McLean 1997) *(see box 3)*.

Social Equity

Social equity essentially means fairness, in that rights to use the atmosphere are fairly allocated and that we all share the burden and the benefits of curbing climate change. Giving away the permits would

exacerbate social inequities through what could amount to one of the largest corporate giveaways ever, possibly up to $300 billion per year. These benefits would accrue directly to those industries that received free permits. The alternative—pollution charges—would create a revenue source that could be used to help workers, communities, businesses, and consumers transition to a clean-energy economy. Finally, charging polluters means that the right to use the atmosphere is owned by the public, not a few special interests.

How can the United States help ease the transition to a clean-energy economy?

Requiring polluters to pay for greenhouse gas emissions creates revenue to compensate those hurt by policies to abate global warming, thus helping ease the transition to clean energy. In fact, President Clinton's Climate Change Action proposal asserts that the United States has a moral imperative to help businesses and workers who are financially harmed by such policies. Where will the money for compensation come from? If there are no emissions charges, there will be no dedicated revenue source. Then when transition assistance is needed, workers and low-income consumers will have to fight for compensation out of an already shrinking pot of government spending. Without a new source of revenue, taxes will need to be increased, which will exacerbate energy price increases, or other programs will need to be cut, thus creating unnecessary hardship. Charging polluters and recycling the money into the economy to businesses, workers, and consumers will allow us to slow global warming equitably.

Wouldn't giving away the rights to pollute mean that energy and gas prices won't rise?

No, policies to mitigate global warming will restrict greenhouse gas emissions, which under any policy—giveaways, auctions, or regulations—will cause prices to increase. Aside from the special case in note 3, prices will increase because the price of the right to emit greenhouse gases, as is the case with any other good that people want, is determined by its scarcity. Restricting greenhouse gas emissions is essentially restricting access to the atmosphere, which was formerly used freely by emitters. It is this restriction that gives the rights to pollute their value. Charging polluters would prevent policies to combat global warming from lining the pockets of the lucky few firms (their executives and shareholders) with billions worth of free permits.

> "Scarcity rent is what landlords—or any owners of highly demanded things whose supply is fairly fixed—get to collect from other people just because of scarcity. The scarcer (relative to demand) things like buildable land, Van Gogh paintings, Mark McGwire home run balls, taxi medallions, and slivers of the broadcast spectrum become, the higher their scarcity rents rise. The same is true for the atmosphere's ability to soak up the effluvium of fossil fuels." (Barnes 1999)

Who should own the atmosphere?

The atmosphere, like many limited natural resources, is a "common asset," one that belongs to all citizens equally. A limited public resource has value when someone wants to use it. In the case of rights to use the atmosphere, it should be managed for the benefit of all citizens, not a few powerful special interests. If the polluters are not charged for emissions, it will imply that citizens do not have a property right claim to a clean environment. Rather, it will send the message that the atmosphere is "owned" by polluting firms. If the United States chooses to limit greenhouse gas emissions, but allows some the valuable right to use the atmosphere for their own profit, then we owe it to ourselves and future generations to make sure we get paid for that use.

Environmental Protection

A first important step toward protecting the environment is to build political will for action to reduce the risk of climate change. Building political will for reducing greenhouse gas emissions necessitates

BOX 3: THE UNITED STATES ACID RAIN TRADABLE EMISSIONS PROGRAM

The U.S. Congress created the Sulfur Dioxide (SO_2) Allowance trading program in 1990 to reduce acid precipitation, popularly known as acid rain. The program targeted emissions from electrical utilities and is the first nationally mandated, market-based approach to an environmental problem (McLean 1997).

Early efforts to control SO_2 involved command-and-control regulations, where the government told utilities how to reduce SO_2 by mandating tall stacks and scrubbers. This regulatory approach was only partially successful for several reasons. First, regulations didn't allow the reductions resulting from other actions to count, such as switching to cleaner coal, even when they reduced emissions by a greater amount and at a lower cost. Second, the tall stacks appeared to increase acid rain in other locations, thus they shifted, and did not solve, the problem (Joskow and Schmalensee 1997).

Because of these problems, environmental pressures, and other political factors, Congress passed the Clean Air Act amendments in 1990 that created the Allowance trading program (Joskow and Schmalensee 1997). The program is designed to result in a 50 percent reduction in SO_2 emissions from 1980 levels by the year 2000. A series of lessons are emerging that can inform a greenhouse gas emissions trading system.

The SO_2 trading program is resulting in cost-effective acid rain reductions. It is estimated that the costs of reducing SO_2 emissions through a trading program can ultimately save up to $3.1 billion by the year 2002 relative to a command-and-control regulatory approach (U.S. Congress 1997).

Despite this success, it appears that the SO_2 program could have saved even more money had it not freely given away emissions permits. Initially, agencies developed a few formulas to allocate the permits, which took into account different fuels and historic pollution reduction efforts. However, as special interests began to assert themselves into the process in order to obtain the greatest number of these valuable permits, these few rules multiplied into 29 formulas, which increased costs, delayed implementation, and resulted in lawsuits. The complicated formulas are responsible for about $1.4 million in added costs of developing and supporting the trading program (McLean 1997).

Clearly an auction system would have avoided the added $1.4 million in costs of implementing the complex rules, in addition to the time and money spent lobbying for the special allowances. Further, auctioning the permits could generate about $1 billion per year that could be used to help compensate displaced coal miners, and other impacted workers, consumers, and industries in the utility sector.

crafting policies that avoid creating hardships for any group. Once action is taken to reduce emissions, the development and economy-wide adoption of new and existing clean-energy technologies must be the backbone of any effort to slow global warming. The widespread use of clean energy will permanently reduce emissions while lowering energy costs and creating new job opportunities (British Petroleum et al. 1998; Bernow et al. 1999). Therefore, policymakers should choose the policy that both creates political will to reduce greenhouse gas emissions and creates the best incentives for the widespread adoption of clean-energy technologies.

What policy would create a broad constituency, thus political will, for action to reduce the risk of climate change?

In terms of fairness, economic efficiency, and spurring technological innovation, the evidence supporting pollution charges is overwhelming. However, policy choices are also based on politics. As noted earlier, some resist proposing greenhouse gas charges because they believe these charges will decrease the likelihood of action to reduce greenhouse gas emissions (see H. John Heinz III Center 1998; Petsonk et al. 1998). However, a broader political constituency can be built by taxing pollution or auctioning permits, then recycling the revenue generally to the economy and providing assistance to businesses, workers, and consumers. Using this approach builds a broad coalition because no one group would bear the majority of the burden of reducing emissions. The revenue could guarantee protection for workers, businesses, and low- and middle-income consumers from rapid and unpredictable price changes.

What policy provides the greatest incentives for the development and widespread adoption of clean-energy technologies?

All market-based policies—emissions taxes, auctioned or free permits—offer the greatest incentives for firms to develop and adopt new technologies relative to command-and-control regulations (Fischer et al. 1998; Jung et al. 1994; Milliman and Prince 1989). Of these market-based policies, auctioned permits or emissions taxes are the best means of inducing technological change (Fischer et al. 1998).[10] Taxes and auctioned permits offer greater incentives because firms save money when they emit less, because low-carbon technologies lower their costs of reducing emissions and allow firms to pay less taxes or buy fewer permits.

There are three steps to the widespread adoption of clean energy: developing a new idea (invention); limited use of the invention (innovation); and broad, economy-wide use of the invention (diffusion) (Jaffe and Stavins 1995). Auctioning permits, in particular, raises the rewards to those companies that promote the diffusion of clean-energy alternatives, the last and critical step (Jung et al. 1994; Milliman and Prince 1989). When firms receive permits free of charge, however, they want only to minimize their own emissions so that they receive the same number of free permits, but use only a fraction of them. They can then sell their extra permits. There is no incentive for them to promote their technology economy-wide because, as an entire industry adopts the innovations, the scarcity of, and therefore the price of, emissions permits decreases, thus decreasing the value of the firm's asset (the permits). Technological innovation, under free permits, would therefore be a halting, individual occurrence rather than a continual, industry-wide process that rewards market transformation.

CONCLUSION

Charging polluters will allow us to slow climate change while maintaining a stable economy and ensuring social equity. Pollution charges accomplish this by reducing greenhouse gas emissions while keeping costs to the economy low, evenly distributing the costs of reducing emissions, and encouraging rapid transition to a clean-energy economy. We believe that a broad constituency will support greenhouse gas emissions reductions when it is clear that policymakers in Congress and the White House choose to protect the environment in a way that is more fair and less costly to all businesses, consumers, citizens, and workers. Creating this broad constituency will ultimately speed action to avert climate change.

ENDNOTES

1. This is the first in a series of papers highlighting why it is imperative that the United States auction greenhouse gas emissions permits or tax pollution. This paper presents an overview of the reasons not to give away pollution rights. Subsequent reports will expand on the individual arguments. Please direct any comments, queries, or requests for additional information to Redefining Progress, One Kearny Street, Fourth Floor, San Francisco, CA 94108. Phone: 415-781-1191, Web site: <http://www.rprogress.org>. We would like to express our gratitude to the Wallace Global Fund and the Turner Foundation, whose support made this work possible.

2. In no way is the term "rights to pollute" meant to suggest that anyone has an entitlement to pollute. Rather, as used here, it acknowledges that greenhouse gas emissions can not be immediately drastically reduced without severe social disruption. Instead, the United States will likely first put moderate limits on emissions, thus temporarily granting companies an emissions "right."

3. The deficiencies of grandfathering permits based on past emissions have been widely noted. One of the greatest is that windfall profits are created for firms that receive free permits. Some have proposed free-distribution schemes that improve on grandfathering. One prominent alternative bases allowances on the firm's projected output. The needed allocation is then regularly updated. While the details can not be fully discussed here, this system helps lower price effects and decreases windfall profits to firms (e.g., Lashof et al. 1997; Burtraw et al. 1999). Output-based allocation would become incredibly unwieldy for the economy as a whole, which includes thousands of different products. However, because this approach is based on output, it would be feasible for the electric utility sector, where the output (electricity) is homogenous. While this distribution scheme improves upon grandfathering, it does not offer revenue for transition assistance and is not as economically efficient as taxes or auctioned permits.

4. Resources for the Future proposes to cap emissions at 1990 levels. They also propose to cap the price of the permits at $25 (Kopp et al. 1999).

5. This figure was estimated using population projections for 2010 from the U.S. Census Bureau, U.S. Department of Commerce, <http://www.census.gov/>.

6. Right-left coalitions have formed arguing for an end to public subsidies for private interests (e.g., Green Scissors, a coalition of Friends of the Earth, Taxpayers for Common Sense, and U.S. Public Interest Research Group; see Kripke et al. 1999); consumer rights organizations argue to end public giveaways (e.g., Common Cause 1997); and politicians such as Bob Dole, John McCain, and Barney Frank argue to end giveaways of public resources (Dole 1997; Common Cause 1997).

7. The United States issued allowances to importers and producers of ozone-depleting chemicals based on each firm's market share in 1986 (Lee 1996, 33).

8. This contention is well supported in the economics literature. See the following for more information: Cramton and Kerr 1998; Cramton 1997; Repetto and Austin 1997). For a large collection of relevant papers see: <http://www.cramton.umd.edu/Auction-Papers.htm>.

9. More information on Sky Trust can be found on the Web at <http://www.cfed.org>.

10. Depending on the circumstances, auctioned permits or emissions taxes may be the preferable policy, in terms of inducing technological innovation. One recent study indicated that taxes provide better incentives to innovate when other firms are unable to imitate the new technologies, while auctioned permits do better when firms are able to imitate the innovations (Fischer et al. 1998).

REFERENCES

BARNES, PETER. 1999.
"The Pollution Dividend." *The American Prospect*, May–June. [WWW document]. Accessed August 26, 1999: <http://epn.org/prospect/44/44barnes.html>.

BERNOW, STEPHEN, KARLYNN COREY, WILLIAM DOUGHERTY, MAX DUCKWORTH, SIVAN KARTHA, AND MICHAEL RUTH. 1999.
America's Global Warming Solutions. A study prepared by Tellus Institute with Economic Research Associates for World Wildlife Fund and the Energy Foundation. Washington, D.C.: World Wildlife Fund.

BRITISH PETROLEUM, GENERAL MOTORS, MONSANTO, WORLD RESOURCES INSTITUTE. 1998.
Building a Safe Climate, Sound Business Future. Washington, D.C.: World Resources Institute.

BURTRAW, DALLAS, KAREN PALMER, AND ANTHONY PAUL. 1999.
"Simulation Results of Alternative Schemes for Allocating NOx Emission Allowances." Discussion Draft. Washington, D.C.: Resources for the Future.

COMMON CAUSE. 1997.
Channeling Influence: The Broadcast Lobby and the $70-Billion Free Ride. Washington, D.C.: Common Cause.

CRAMTON, PETER. 1997.
"The Federal Communications Commission Spectrum Auctions: An Early Assessment." *Journal of Economics and Management Strategy* 6(3):431–495.

_____. 1995.
"Money out of Thin Air: The Nationwide Narrowband PCS Auction." *Journal of Economics and Management Strategy* 4:267–343.

CRAMTON, PETER, AND SUZI KERR. 1999.
"The Distributional Effects of Carbon Regulation: Why Auctioned Carbon Permits Are Attractive and Feasible." In *The Market and the Environment*, ed. Thomas Sterner. Cheltenham, United Kingdom: Edward Elgar.

_____. 1998.
Tradable Carbon Allowance Auctions: How and Why to Auction. Washington, D.C.: Center for Clean Air Policy.

DOLE, BOB. 1997.
"Giving Away the Airwaves." *New York Times*, 27 March 1997, Op-ed.

FISCHER, CAROLYN, IAN W. H. PARRY, AND WILLIAM A. PIZER. 1998.
"Instrument Choice for Environmental Protection When Technological Innovation Is Endogenous." Discussion Paper 99-04. Washington, D.C.: Resources for the Future.

HAMOND, M. JEFF, STEPHEN J. DECANIO, PEGGY DUXBURY, ALAN H. SANSTAD, AND CHRISTOPHER H. STINSON. 1997.
Tax Waste, Not Work: How Changing What We Tax Can Lead to a Stronger Economy and a Cleaner Environment. San Francisco: Redefining Progress.

H. JOHN HEINZ III CENTER FOR SCIENCE, ECONOMICS, AND THE ENVIRONMENT. 1998.
Designs for Domestic Carbon Emissions Trading. Washington, D.C.: The H. John Heinz III Center for Science, Economics, and the Environment.

JAFFE, ADAM B., AND ROBERT N. STAVINS. 1995.
"Dynamic Incentives of Environmental Regulations: The Effects of Alternative Policy Instruments on Technology Diffusion." *Journal of Environmental Economics and Management* 29(3 Suppl. Part 2):S43–S63.

JOSKOW, PAUL L., AND RICHARD SCHMALENSEE. 1998.
"The Political Economy of Market-Based Environmental Policy: The U.S. Acid Rain Program." *Journal of Law and Economics* 41(1):37–84.

JUNG, CHULHO, KERRY KRUTILLA, AND ROY BOYD. 1994.
"Incentives for Advanced Pollution Abatement Technology at the Industry Level: An Evaluation of Policy Alternatives." *Journal of Environmental Economics and Management* 30:95–111.

KOPP, RAYMOND J., RICHARD D. MORGENSTERN, WILLIAM PIZER, AND MICHAEL A. TOMAN. 1999.
Proposal for Credible Early Action in U.S. Climate Policy. [WWW document]. Accessed September 1, 1999: <http://www.weathervane.rff.org/features/feature060.html>.

KRIPKE, GAWAIN, BETH MOORMAN, AND ERICH PICA, EDS. 1999.
Green Scissors 99: Cutting Wasteful and Environmentally Harmful Spending. Washington, D.C.: Friends of the Earth. Also available at <www.foe.org/eco/scissors99/welcome.html>.

LASHOF, DANIEL A., TIM HARGRAVE, AND SAM KELLER. 1997.
"Output-Based Allocation of Emission Allowances." Discussion Draft. Washington, D.C.: Natural Resources Defense Council.

LEE, DAVID. 1996.
"Trading Pollution." In *Ozone Protection in the United States: Elements of Success*, ed. Elizabeth Cook, 31–37. Washington, D.C.: World Resources Institute.

MCLEAN, J. DAVID. 1997.
"Evolution of Marketable Permits: The U.S. Experience with Sulfur Dioxide Allowance Trading." *International Journal of Environment and Pollution* 8:19–36.

MILLIMAN, SCOTT R., AND RAYMOND PRINCE. 1989.
"Firm Incentives to Promote Technological Change in Pollution Control." *Journal of Environmental Economics and Management* 17:247–265.

PARRY, IAN W., ROBERTON C. WILLIAMS III, AND LAWRENCE H. GOULDER. 1996.
"When Can Carbon Abatement Policies Increase Welfare? The Fundamental Role of Distorted Factor Markets." Discussion Paper 97–18. Washington, D.C.: Resources for the Future.

PETSONK, ANNIE, DANIEL J. DUDEK, AND JOSEPH GOFFMAN. 1998.
Market Mechanisms and Global Climate Change: An Analysis of Policy Instruments. Environmental Defense Fund in cooperation with the Pew Center on Global Climate Change. Washington, D.C.: Pew Center on Global Climate Change.

REPETTO, ROBERT, AND DUNCAN AUSTIN. 1997.
The Costs of Climate Protection: A Guide for the Perplexed. Washington, D.C.: World Resources Institute.

U.S. CONGRESS. JOINT ECONOMIC COMMITTEE. 1997.
Tradable Emissions: Hearing before the Joint Economic Committee. Statement of Peter F. Guerrero, U.S. General Accounting Office, entitled "Air Pollution–Overview and Issues on Emissions Allowance Trading Programs." 105th Congress, 1st session. 7 July.

WEFA. 1998.
"Global Warming: The High Cost of the Kyoto Protocol—National and State Impacts." Eddystone, PA: WEFA, Inc. Also available at http://www.api.org/globalclimate/wefapdf/ntl98.pdf.

WOLFF, GARY, AND GAUTAM SETHI. FORTHCOMING.
"What's Fair for Workers and Investors?" San Francisco: Redefining Progress.