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Global Climate Change: Market-Based Strategies to Reduce Greenhouse Gases

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Global Climate Change: Market-Based Strategies to Reduce Greenhouse Gases

SUMMARY

The possibility that human activities are releasing gases, including carbon dioxide (CO2), at rates that could affect global climate has resulted in proposals for national programs to curtail emissions. An international framework for specific reductions in greenhouse gases was negotiated at a meeting in Kyoto in December 1997. Concern about costs has encouraged consideration of CO2 reduction proposals that employ market-based mechanisms. The passage in 1990 of a tradeable allowance system for sulfur dioxide (SO2) control in the United States provides a precedent for such mechanisms.

The two mechanisms receiving the most attention are a tradeable permit program (similar to the acid rain program) and carbon taxes. Proposed CO2 reduction schemes present large uncertainties in terms of the perceived reduction needs and the potential costs of achieving those reductions. Tradeable permit programs would reduce CO2 emissions to a specific level with the control cost handled efficiently, but not at a specific cost level. Carbon taxes would effectively cap marginal control costs at the specific tax level, but the precise level of CO2 achieved would be less certain. Hence, a major policy question is whether one is more concerned about the possible cost of the program and therefore willing to accept some uncertainty about emission reduction in order to have some limits on costs (i.e., carbon taxes) or whether one is more concerned about achieving a specific emission reduction level with costs handled efficiently, but not capped (i.e., tradeable permits).

The specific effects of both a carbon tax and tradeable permit program would depend on the specific levy (carbon tax) or allocation scheme (tradeable permit) chosen, the scope of the program, the timing of the reductions, and the recycling of any revenues.

In addition, many tradeable permit proposals include provisions allowing countries to accumulate permits by reducing emissions in other countries. This scheme, called joint implementation, was approved in principle at the Kyoto conference in December, 1997.

The climate change issue and CO2 control raise numerous equity issues. In one sense, climate change is a concern about intergenerational equity — i.e., the well-being of the current generation versus generations to come. On a global level, the issue also involves the North-South debate. At the domestic level, equity questions include the regional distribution of costs under a tradeable permit or carbon tax scheme. For example, an important impact of either a carbon tax based on the carbon content of fossil fuels or a tradeable permit program would be the pressure for fuel shifts away from coal and toward gas. Regions such as fast-growing areas in need of more energy and owners of "all electric" homes, among others, would likely be disproportionately hit by a CO2 control scheme. In addition, people may be affected differently according to income class. These issues, however, have not been sufficiently analyzed at the current time to be sure of how various sectors would be affected.

MOST RECENT DEVELOPMENTS

In February, 2002, the Bush Administration initiated a new voluntary greenhouse gas reduction program. Rather than attempting to meet a specific reduction target, the proposal focuses on improving the carbon efficiency of the economy.

In November 2001, the Seventh Conference of Parties to the Framework Convention on Climate Change concluded negotiations on implementation of the Kyoto Protocol. With respect to flexible implementation mechanisms, the Parties outlined the institutions that would oversee the flexible implementation mechanisms contained in the Protocol. However, the Conference put off deciding on the consequences of non-compliance until a later date.

In July, the Sixth Conference of Parties to the Framework Convention on Climate Change agreed to a draft decision on implementing the Kyoto Protocol. With respect to flexible implementation mechanisms, the Parties agreed to exclude nuclear power as a possible non-carbon alternative under the Clean Development Mechanism and joint implementation program. The Parties also reiterated that use of flexible mechanisms shall be supplemental to domestic efforts. The United States did not participate in these deliberations.

In April, a third bill was introduced in the 107th Congress to reduce carbon dioxide emissions from electric generating facilities. H.R. 1335, introduced by Representative Allen, would reduce and cap carbon dioxide emissions at their 1990 levels by the year 2005.

In March 2001, two bills were introduced in the 107th Congress to reduce carbon dioxide emissions from electric generating facilities to their 1990 levels. In contrast, the Administration announced in March that the Kyoto Protocol was "dead" as far as it was concerned. However, EPA Administrator Whitman emphasized that the Administration hoped to work constructively with the EC to develop technologies and market-based incentives to address global climate change.

BACKGROUND AND ANALYSIS

Certain gases emitted as a result of human activities may be affecting global climate. Most concern centers on the possibility that CO2, along with other gases, could increase global temperatures, with subsequent effects on precipitation patterns and ocean levels that could affect agriculture, energy use, and other human activities.

Status of Global Climate Change Issue and Response

The initial issue of whether the potential for global climate change poses a threat that justifies prompt action to curtail CO2 and other so-called greenhouse gases remains actively

debated—both domestically and internationally. (For a review of the technical dimensions of this question, see CRS Issue Brief IB89005, *Global Climate Change*.) Some view the risks as sufficiently grave and urgent to justify immediate action. Others are uncertain of the risks but believe that selected policies to reduce emissions can be justified for other reasons and would provide insurance if the risks were borne out; these other reasons include improved energy efficiency, reduced reliance on imported oil, and increased revenues. Still others caution that actions to reduce CO2 and other greenhouse gases could disrupt the nation's economy and should not be undertaken unless further scientific evidence of risks becomes available.

Despite the uncertainties, however, scientists and policymakers have increasingly adopted the view that human activities are releasing greenhouse gases at rates that could affect global climate. As a result, initiatives are underway to address the issue, resulting in proposals for national and international programs to curtail emissions.

An agreement on a United Nations' Framework Convention on Climate Change was on the agenda at the U.N. Conference on Economic Development in Rio de Janeiro in June 1992. The United States was an early signatory to the agreement, which was approved by the Senate October 7, 1992. In April 1993, President Clinton directed the federal government to craft a plan that would stabilize U.S. greenhouse gas emissions at 1990 levels by the year 2000 (see CRS Report 94-404, *Climate Change Action Plans*). However, in 2000, the United States did not meet its voluntary commitment at Rio to stabilize greenhouse gas emissions at 1990 levels. Indeed, it is unclear when U.S. carbon emissions may stabilize. A November 2001 draft *Climate Action Report* by the Administration estimates U.S. carbon emissions in the year 2010 will be 34% above their 1990 levels. (For more on U.S. domestic climate change policy since Rio, see CRS Report RL30024, *Global Climate Change Policy: Cost, Competitiveness, and Comprehensiveness*.)

Meanwhile, the United States and other signatories to the Climate Change Convention met in December 1997 in Kyoto, Japan, to conclude negotiations on a binding protocol for specific provisions to reduce greenhouse gas emissions. The final protocol agreed to at Kyoto requires the United States to reduce emissions of six greenhouse gases (CO2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride) by 7% on average from 1990 levels over the period 2008-2012. In November 1998, the parties met in Buenos Aires to develop work plans for specific elements of the Kyoto Protocol, including the trading of emission reductions and the Clean Development Mechanism. The parties decided that these work plans should be completed by the year 2000. The November 1999 meeting in Bonn postponed decisions about emissions trading until the November 2000 meeting at the Hague. The meeting at The Hague failed to arrive at agreement on emissions trading, and further negotiations are scheduled for May 2001. In March, 2001, The current Bush administration announced that it was formally abandoning the emission targets set under Kyoto. (For more on the U.S. reduction requirement under Kyoto, see CRS Report 98-235 ENR, *Global Climate Change: U.S. Greenhouse Gas Emissions — Status, Trends, and Projections*)

This decision by the current Bush Administration has not deterred the international community. In July 2001, the Sixth Conference of Parties to the Framework Convention on Climate Change agreed to a draft decision on implementing the Kyoto Protocol. With respect to flexible implementation mechanisms, the Parties agreed to exclude nuclear power as a possible non-

carbon alternative under the Clean Development Mechanism and joint implementation program. The Parties also reiterated that use of flexible mechanisms shall be supplemental to domestic efforts. The United States did not participate in these deliberations. In November 2001, the Seventh Conference of Parties to the Framework Convention on Climate Change concluded negotiations on implementation of the Kyoto Protocol. With respect to flexible implementation mechanisms, the Parties outlined the institutions that would oversee the flexible implementation mechanisms contained in the Protocol. However, the Conference put off deciding on the consequences of non-compliance until a later date. The United States was a non-participant to most of what took place at this conference.

Thus, despite continuing uncertainties about the risks of global climate change, proposals for addressing it are going forward, and it is the content of those proposals rather than the issue of whether the problem is exigent that is the focus of this brief.

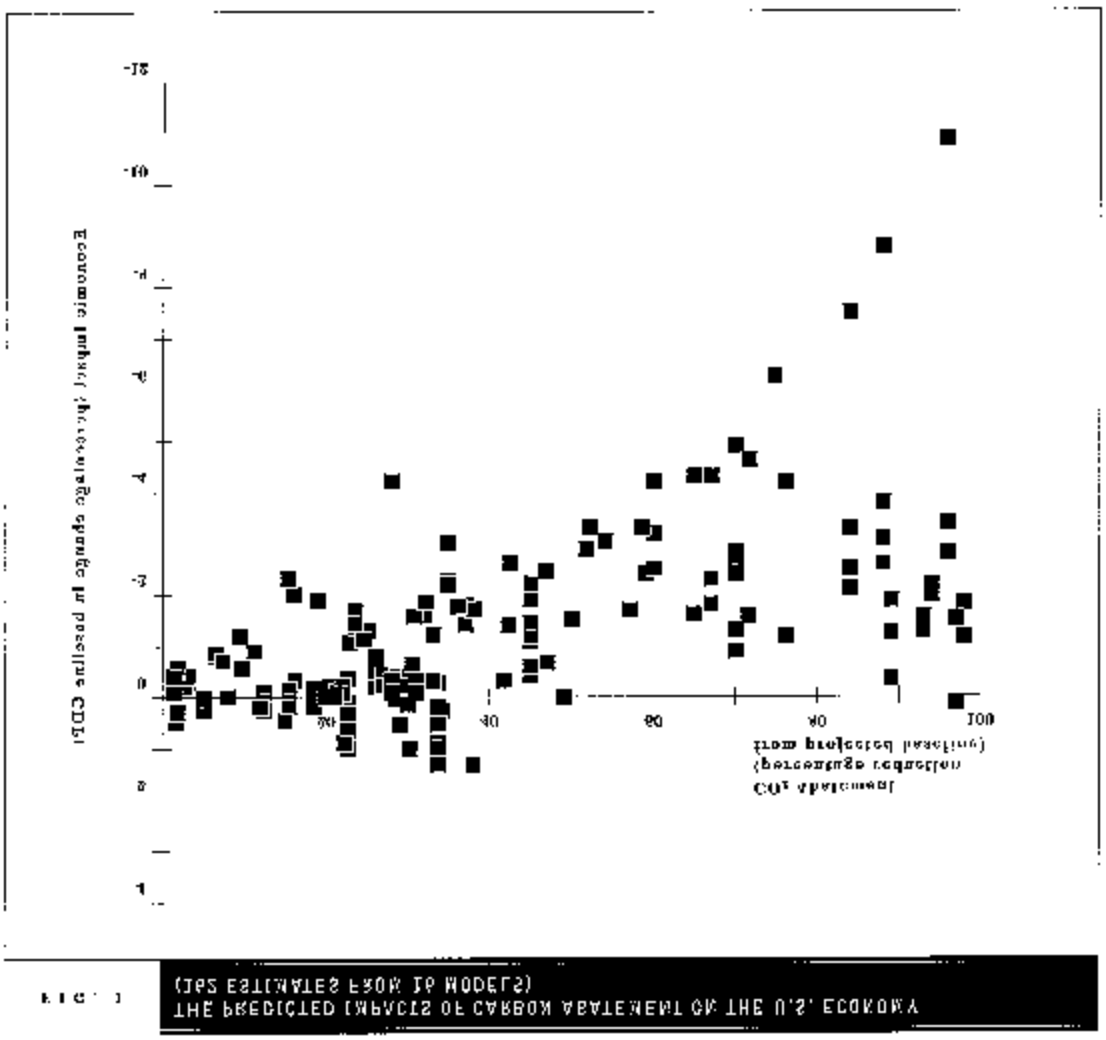
Estimating Cost Impacts of Controls

Estimates of costs to reduce CO2 emissions vary greatly, and focus attention on an estimator's basic beliefs about the problem and the future, rather than on simple, technical differences, in economic assumptions. (See CRS Report 98-738, *Global Climate Change: Three Policy Perspectives*. It identifies three "lenses" through which people can view the global climate change issues, and their influence on cost analysis.) These are summarized in Table 1. None of these perspectives is inherently more "right" or "correct" than another; rather, they overlap and to varying degrees complement and conflict with each other. People hold to each of the lenses to some degree.

However, the differing perspectives lead to very different cost estimates. Figure 1 below shows a scatter-plot by World Resources Institute (WRI) of the predicted impacts from 162 estimates from 16 different economic models on the U.S. economy from a CO2 abatement program. Although the size of the proposed CO2 reduction and the time allowed to achieve it (not explicitly modeled in the WRI report) are critical factors in determining the costs and benefits of any reduction program, WRI found underlying modeling assumptions not related to policy decisions explained a significant amount of the difference in the estimates. For example, consistent with a "technological" view of the problem, models that assumed technological development of non-carbon substitutes for current fossil fuel use, along with increased energy and product substitutions, had significantly less cost than models that assumed such advancements would not occur in a timely fashion. For example, a recent study by the American Council for an Energy-efficient Economy (ACEEE) argues that carbon emissions could fall 10% below 1990 levels by 2010 with a net economic savings of $58 billion along with 800,000 new jobs. Such savings are assumed to come from new technology and market mechanisms to encourage cost-effective implementation strategies. Such a position presumes that technologies are available now, or will be very shortly, that can achieve these reductions cost-effectively.

Likewise, consistent with an "ecological" perspective, models that included the benefits of air pollution damages and climate change damages averted by the CO2 reduction estimated considerably less costs to the economy than models that did not include such benefits. The WRI

report suggests that the cost profile of a CO2 reduction program changes substantially if one includes the benefits of air pollution and climate change effect averted by controlling CO2. The Clinton Administration's 1998 analysis of costs to comply with Kyoto estimates benefits from controlling ancillary pollutants (SO2, NOx, and fine particulates) at between $1.8 and $10.6 billion annually.



Consistent with an "economic" perspective, models that included policy approaches that encouraged efficient economic responses to CO2 reductions, that included joint implementation schemes, and involved efficient recycling of any revenues from control strategies, significantly reduced costs over models runs that did not include such policy options. Like the technology perspective, economically efficient solutions assume that the program is implemented in such a way to permit the economy sufficient time to absorb the new price signals with minimal short-term constraints.

The uncertainty about the risk of climate change and the critical impact of assumptions about the nature of the problem effectively preclude predictions of the ultimate costs of reducing greenhouse gases. As a result, attention has focused on how to minimize costs by selecting the most economically efficient strategies to reduce CO2 emissions. Traditionally, air pollution control programs have relied on various "command and control" regulatory approaches, including ambient quality and technology-based standards. But increasingly, economic efficiency concerns have been directed toward supplementing regulatory control with market-based mechanisms, including pollution taxes and tradeable permits. (For more on the pros and cons of economic mechanisms in pollution control, see CRS Report 89-360 ENR, *Using Incentives for Environmental Protection: An Overview*, and CRS Report 94-213, *Market-Based Environmental Management: Issues in Implementation*.)

The tradeable allowance system for SO2 control in the acid rain program enacted in 1990 represents a significant step in this evolution of economic mechanisms. Acceptance of this system has led to calls for use of a similar system with other pollutants, including CO2. Three bills proposing a tradeable permit-type system to begin controlling CO2 emissions have been introduced in the 107th Congress.

Table 1: Influence of Climate Change Perspectives on Policy Parameters

Approach	Seriousness of Problem	Risk in developing mitigation program	Costs
Technology	Is agnostic on the merits of the problem. The focus is on developing new technology that can be justified from multiple criteria, including economic, environmental and social perspectives.	Believes any reduction program should be designed to maximize opportunities for new technology. Risk lies in not developing technology by the appropriate time. Focus on research, development, and demonstration; and on removing barriers to commercialization of new technology.	Viewed from the bottom-up. Tends to see significant energy inefficiencies in the current economic system that currently (or projected) available technologies can eliminate at little or no overall cost to the economy.
Economic	Understands issue in terms of quantifiable cost-benefit analysis. Generally assumes the status quo is the baseline from which costs and benefits are measured. Unquantifiable uncertainty tends to be ignored.	Believes that economic costs should be examined against economic benefits in determining any specific reduction program. Risk lies in imposing costs in excess of benefits. Any chosen reduction goal should be implemented through economic measures such as tradeable permits or emission taxes.	Viewed from the top-down. Tends to see a gradual improvement in energy efficiency in the economy, but significant costs (quantified in terms of GDP loss) resulting from global climate change control programs. Typical loss estimates range from 1-2% of GDP.

Approach	Seriousness of Problem	Risk in developing mitigation program	Costs
Technology	Is agnostic on the merits of the problem. The focus is on developing new technology that can be justified from multiple criteria, including economic, environmental and social perspectives.	Believes any reduction program should be designed to maximize opportunities for new technology. Risk lies in not developing technology by the appropriate time. Focus on research, development, and demonstration; and on removing barriers to commercialization of new technology.	Viewed from the bottom-up. Tends to see significant energy inefficiencies in the current economic system that currently (or projected) available technologies can eliminate at little or no overall cost to the economy.
Ecological	Understands issues in terms of its potential threat to basic values, including ecological viability and the well-being of future generations. Such values reflect ecological and ethical considerations; adherents see attempts to convert them into commodities to be bought and sold as trivializing the issue.	Rather than economic costs and benefits or technological opportunity, effective protection of the planet's ecosystems should be the primary criterion in determining the specifics of any reduction program. Focus of program should be on altering values and broadening consumer choices.	Views costs from an ethical perspective in terms of the ecological values that global climate change threatens. Believes that values such as intergenerational equity should not be considered commodities to be bought and sold. Costs are defined broadly to include aesthetic and environmental values that economic analysis cannot readily quantify and monetize.

Market-Based Mechanisms for Reducing Greenhouse Gases

Proposals to use market mechanisms to implement greenhouse gas emission reductions have revolved around three approaches: tradeable permits (as "allowances" and as "credits"), carbon taxes, and joint implementation. The protocol negotiated at Kyoto contains articles on emissions trading and joint implementation. These provisions were strongly supported by the Clinton Administration. In addition, some European countries have implemented or are considering carbon taxes to bring about greenhouse gas reductions in their countries.

Tradeable Permits (Allowances)

A model for a tradeable permit approach is the SO2 allowance program contained in Title IV of the 1990 Clean Air Act Amendments. The Title IV program is based on two premises.

First, a set amount of SO2 emitted by human activities can be assimilated by the ecological system without undue harm. Thus the goal of the program is to put a ceiling, or cap, on the total emissions of SO2 rather than limit ambient concentrations. Second, a market in pollution rights between polluters is the most cost-effective means of achieving a given reduction. This market in pollution rights (or allowances, each of which is equal to one ton of SO2) is designed so that owners of allowances can trade those allowances with other emitters who need them or retain (bank) them for future use or sale. Initially, most allowances were allocated by the federal government to utilities according to statutory formulas related to a given facility's historic fuel use and emissions; other allowances have been reserved by the government for periodic auctions to ensure the liquidity of the market.

Conceptually, a CO2 tradeable permit program could work similarly. Some number of CO2 allowances could be allocated, and a market in the allowances would permit emitters to use, sell, buy, or bank them. However, significant differences exist between acid rain and possible global warming that may affect the appropriateness of a Title IV-type response to CO2 control. For example, the acid rain program may involve up to 3,000 new and existing electric generating facilities that contribute two-thirds of the country's SO2 and one-third of its nitrogen oxide (NOx) emissions (the two primary precursors of acid rain). This concentration of sources makes the logistics of allowance trading administratively manageable and enforceable. However, CO2 emissions are not so concentrated. Although over 95% of the CO2 generated comes from fossil fuel combustion, only about 33% comes from electricity generation. Transportation accounts for about 33%, direct residential and commercial use about 12%, and direct industrial use about 20%. Thus, small dispersed sources in transportation, residential/ commercial, and the industrial sectors are far more important in controlling CO2 emissions than they are in controlling SO2 emissions. This creates significant administrative and enforcement problems for a tradeable permit program if it attempts to be comprehensive.

These concerns multiply as the global nature of the climate change issue is considered, along with other potential greenhouse gases. Article 3 of the protocol negotiated at Kyoto emphasizes that any international emissions trading should be supplemental to a country's domestic efforts, not a substitute for them.

Current SO2 allowance trading plans between individual utilities do not shed much light on how well the existing allowance market will work over the long-term. Some individual trades between utilities and EPA-sponsored auctions have been conducted, but the current level of trading activity has not established the viability of the marketplace. For a market to thrive, transactions must become sufficiently commonplace for an open, public market price to be established with limited bilateral negotiation. Based on the results of the EPA auctions conducted by the Chicago Board of Trade, allowance prices are considerably below that anticipated when the legislation was enacted. However, the six-year experience of the SO2-allowance market may be insufficient to give much guidance on how well a CO2-allowance market might work.

Tradeable Permits (Credits)

As noted above, a tradeable allowance involves future emissions. An allowance is a limited authorization to emit a ton of pollutant; allowances are allocated to an emitting facility under an

applicable emission limitation at the beginning of a year. The facility decides whether to use, trade, or bank those allowances, depending on its emissions strategy. Then, at the end of the year, the agency compares an emitting facility's actual emissions with its available allowances to determine compliance.

A different approach to creating a tradeable permit program is to use credits instead of allowances. A credit is created when a facility actually emits a pollutant at less than its allowable limit as defined in by the program. An example of this type of program is EPA's "Emission Reduction Credit program" (ERC) under the Clean Air Act. Under the ERC program, EPA requires that any credit created under a state program implementing emissions trading be "surplus, enforceable (by the state), permanent, and quantifiable." Thus, a state must certify the creation of the credit, unlike an allowance program, where allocation is dictated by a statutory or regulatory formula. Any CO2 reduction credit program could build on EPA's and states' experience with the current emission reduction credit program.

The primary advantage of a credit program over an allowance program is that it does not discriminate against new sources. Allowance programs tend to allocate their allowances based on some historic baseline year. Those sources included in the baseline get their allowances free. Those future sources not included in the baseline have to pay either the older, existing sources to obtain allowances or to buy allowances at auction. With a credit program, sulfur credits can be created by any source, as the baseline is dictated by the emissions cap and yearly production, not a historical year. The disadvantage of such a system is that facility planning is very difficult as operators do not know precisely what their permissible limit will be from year to year.

Carbon/CO2 Emissions Tax

An alternative market-based mechanism to the tradeable permit system is carbon taxes — generally conceived as a levy on natural gas, petroleum, and coal according to their carbon content, in the approximate ratio of 0.6 to 0.8 to 1, respectively. In the view of most economists, the most efficient approach to controlling CO2 emissions would be a carbon tax. With the complexity of multiple pollutants and millions of emitters involved in controlling CO2, the advantages of a tax are self-evident. Imposed on an input basis, administrative burdens such as stack monitoring to determine compliance would be reduced. Also, a carbon tax would have the broad effect across the economy that some feel is necessary to achieve long-term reductions in emissions.

However, in other ways, a tax system merely changes the forum rather than the substance of the policy debate. Because paying an emissions tax becomes an alternative to controlling emissions, the debate over the amount of reductions necessarily becomes a debate over the tax level imposed. Those wanting large reductions quickly would want a high tax imposed over a short period of time. Those more concerned with the potential economic burden of a carbon tax would want a low tax imposed at a later time with possible exceptions for various events. Emissions taxes would remain basically an implementation strategy; policy determinations such as tax levels would require political/regulatory decisions. In addition, a tax system would raise revenues. Indeed, one argument for—or against—such a system would be that it is a tax that would raise revenues. The disposition of these revenues would significantly affect the economic and distributional impacts of

the tax. (For further information, see CRS Report 92-623 ENR, *Carbon Taxes: Cost-Effective Environmental Control or Just Another Tax?*)

Other tax schemes to address global climate change are also possible. For example, the European Community (EC) has discussed periodically a hybrid carbon tax/energy tax to begin addressing CO2 emissions. Fifty percent of the tax would be imposed on energy production (including nuclear power) except renewables; 50% of the tax would be based on carbon emissions. Some European countries have modified their energy taxation to fit the model discussed by the EC.

Currently, five European countries have carbon-based taxes. Finland imposed the first CO2 tax in 1990 and modified it in 1994. The Finnish tax has two components: (1) a basic tax component to meet fiscal needs and (2) a combined energy/CO2 tax component. For coal, peat, and natural gas, there is no fiscal component. The Netherlands also introduced a CO2 tax in 1990, modified in 1992 to fit the EC model. It does include tax relief from the energy component of the tax for energy-intensive industries. Sweden introduced a CO2 tax in 1991 on all fossil fuels, unless it is used in electricity production. In 1993, the tax scheme was modified to reduce its burden on industry. Denmark introduced a CO2 tax in 1992 that covers fuel oil, gas, coal, and electricity (gasoline is taxed separately). Taxes paid by industry are completely reimbursed to the sector. Norway introduced a CO2 tax in 1991 on oil and natural gas and extended it to some coal and coke use in 1992. However, there are many exemptions and the tax rate is not differentiated according to the carbon content of the fuels. Likewise, the Netherlands has a CO2 tax, but the taxes do not vary according to fuel type and energy use.

Joint Implementation

Joint Implementation (JI) is an attempt to expand the availability of cost-effective CO2 reductions into the international sphere through a variety of different activities. Basically, a developed country (where opportunities for reducing emissions are expensive) needing CO2 reductions to meet its obligations under any international treaty could obtain reduction credits by financing emission reductions in another country, usually a developing country (where more cost-effective reductions are available). As generally conceived, the developed country financing the reductions and the developing country hosting the reduction project would split the achieved reductions between them in some previously agreed-upon manner. Joint Implementation is a keystone of U.S. climate change policy; it was subject to considerable debate at the Conference of Parties (COP) meetings in Berlin. These discussions resulted in agreement to implement JI in a pilot phase. Projects must be compatible with and supportive of national environmental and development priorities; accepted, approved, or endorsed beforehand by the Parties' governments; and have anticipated environmental benefits and projected financing fully articulated beforehand. Credits generated cannot be used to meet the Rio Treaty year 2000 target; credit for post-2000 targets was left to the meeting in Kyoto, which included JI as one of its flexible implementation mechanisms.

The focus of the U.S. JI effort is the U.S. Initiative on Joint Implementation (USIJI). Managed by a Secretariat cooperatively staffed by 8 federal agencies, the USIJI is a pilot JI program initiated by the Administration as part of its "Climate Change Action Plan" in 1993.

Currently, there are about 26 projects in 11 countries that have received USIJI approval. The USIJI encourages U.S. industry to use its resources and technology to reduce greenhouse gas emissions and promote sustainable development. (Its web site is [http://www.ji.org].)

The advantage of JI for developed countries is that it widens the options available to obtain necessary credits under any reduction program. This translates into lower costs to those countries, compared with their own domestic reduction activities. For the developed country, particularly where it does not have the resources to control emissions or protect sequestration areas, reductions or protection would occur more quickly than would otherwise be possible.

However, the disadvantages are also significant. A developed country may have to rely on another sovereign government to ensure compliance with part of its international commitment. Governments change, and policies change. If a new government chose to remove or shut down a pollution control device, the developed country might have little recourse but to look elsewhere for its necessary reduction. Particularly with sequestration projects that involve marketable commodities, such as trees, enforcement could be quite difficult. A tree's value as cooking or heating firewood for natives could easily exceed its value as a carbon sequester. In the long-run, the enthusiasm with which a developing country may enforce agreements with respect to JI projects is unclear.

Indeed, developing countries could have significant economic incentives to abrogate JI projects, particularly if they are viewed as constraining necessary development, or locking up a natural resource that the country would like to exploit. This incentive is further encouraged if the JI project is perceived as a developed country's project. The term "economic imperialism" has already be applied to JI projects by some opponents.

After much negotiation, the protocol agreed to at Kyoto contains provisions on joint implementation that generally follow the guidelines set up at Berlin. Because developing countries have no emission requirements to meet (unlike developed countries), the protocol sets up a clean development mechanism to promote sustainable development in them while providing emission reduction opportunities for developed countries. Participation is voluntary; benefits must be real, measurable, and long-term; reductions must be in addition to any normal activity. Operated under supervision of the COP, reductions achieved between 2000 and 2008 may be used to offset commitments in the 2008-2012 time period. In the July 2001 COP-6 meeting, it was agreed that nuclear power was not an acceptable option under the CDM

Issues

Cost-Effectiveness: Price versus Quantity

Proposed CO2 reduction schemes present large uncertainties in terms of the perceived reduction needs and the potential costs of achieving those reductions. In one sense, preference for a carbon tax or tradeable permit system depends on how one views the uncertainty of costs involved and benefits to be received. For those confident that achieving a specific level of CO2

reduction will yield very significant benefits—enough so that even the potentially very high end of the marginal cost curve does not bother them — then a tradeable permit program may be most appropriate. CO2 emissions would be reduced to a specific level, and in the case of a tradeable permit program, the cost involved would be handled efficiently, but not controlled at a specific cost level. This efficiency occurs because control efforts are concentrated at the lowest cost emission sources through the trading of permits.

However, if one is more uncertain about the benefits of a specific level of reduction — particularly with the potential downside risk of substantial control cost to the economy — then a carbon tax may be most appropriate. In this approach, the level of the tax effectively caps the marginal control costs that affected activities would have to pay under the reduction scheme, but the precise level of CO2 achieved is less certain. Emitters of CO2 would spend money controlling CO2 emissions up to the level of the tax. However, since the marginal cost of control among millions of emitters is not well known, the overall effect of a given tax level on CO2 emission cannot be accurately forecasted. Hence, a major policy question is whether one is more concerned about the possible economic cost of the program and therefore willing to accept some uncertainty about the amount of reduction received (i.e., carbon taxes) or whether one is more concerned about achieving a specific emission reduction level with costs handled efficiently, but not capped (i.e., tradeable permits).

A proposal was floated by the Clinton Administration for a tradeable permit program with a ceiling on the price of permits. If permit prices rose above a certain price, the government would have intervene to control costs by selling more permits at a specific price. In essence, this would have given the permit program the character of a carbon tax by controlling costs through a price "safety valve," while allowing quantity to increase to any level necessary to prevent price increases. Not surprisingly, environmental groups interested in protecting the emission limitations of any global climate change program attacked the idea as a "target-busting escape clause." Industry groups suggested that such a tradeable permit program amounts to a tax.

Comprehensiveness

As suggested earlier, carbon emissions are ubiquitous. Much of the emissions comes from the direct combustion of fossil fuels from small, dispersed sources such as automobiles, homes, and commercial establishments. For example, the 12% of emissions from the residential/ commercial sector comes from such things as space heating/cooling (9.3 %, oil and natural gas), water heating (1.5%, mostly natural gas), and appliances (1.2%, mostly natural gas). If one adds to these dispersed sources the 33% of emissions that come from direct combustion from automobiles (13.9%), trucks (11.2%), airplanes (4.5%), ships (1.8%), pipelines (0.6%), and railroads (0.8%), the number of individual sources runs into the millions; very small sources contribute almost half the emissions.

Assuming a carbon tax is assessed on an input basis (i.e., on the carbon content of the fuel), then the number of sources is largely irrelevant — the sources would get the correct price signal from the increased cost of their fuel. This is one of the primary strengths of the carbon tax scheme—it can be very comprehensive and potentially induce the necessary changes in individual as well as corporate behavior that could substantially reduce dependence on carbon emitting

energy sources. In this sense, a carbon tax is not just a band-aid to reduce CO2 emissions, but a program to reduce carbon intensiveness in the economy and in individual lifestyles.

For a tradeable permit program, the numbers of sources can represent a substantial administrative and enforcement problem. One approach to making the situation more manageable would be to limit the scope of the trading system to domestic implementation strategies. As noted above, international emission trading is termed "supplemental" under the consolidated negotiating text. Likewise, the scope could be limited further by focusing the trading program on the electric utility sector. Another approach could be to limit the size of the source included in the trading program. Others could "opt-in," but their participation would be voluntary. Thus, direct combustion of fossil fuels in the residential, commercial, and industrial sectors (e.g., natural gas, home heating oil) would be indirectly encouraged by the program and use of CO2 emitting electricity (particularly coal-fired electricity) discouraged. The transportation sector would be little affected (unless it chose to be).

Economic Impact

Obviously, the economic impact of either a tradeable permit program or a carbon tax depends on the level of reductions desired and the timing of those reductions. Most of the studies on the economic impact of CO2 control programs have focused primarily on carbon taxes. This is not surprising as carbon taxes are easier to model than a tradeable permit program. However, the uncertainty involved in these analyses is quite large; further work is necessary to reduce the current range of estimates. (For further discussion, see CRS Report 92-623 ENR, *Carbon Taxes: Cost-Effective Environmental Control or Just Another Tax?*)

For example, estimates of the carbon tax necessary to stabilize U.S. CO2 emissions at their 1990 level by the year 2000 range from under $30 a ton to over $100 a ton. Economic assumptions that result in this range of estimates include: (1) carbon emissions growth assumptions in the absence of legislation, (2) responsiveness of the economy to the carbon tax in terms of increased energy efficiency, and (3) type of model employed. This uncertainty is compounded when attempts are made to estimate GNP effects of carbon taxes. Very small differences in GNP estimation techniques can result in large differences in projected impacts (particularly over the long term). Preliminary evidence indicates that the adverse effects of a carbon tax can be reduced if the proceeds from that tax are "recycled" either to offset certain existing taxes or fund investment incentives to encourage economic growth (particularly through greater capital formation). Thus, the impact of a carbon tax on the economy would depend to some degree on how the government disposed of generated revenues. However, considerably more work is needed to define the economic consequences of a specific proposal to recycle revenues before much confidence can be put into the results. Of course, if one has an technological or ecological orientation, the assumptions resulting from those orientations can draw the economic assumptions discussed here.

The extent that economic analysis of carbon tax programs provides insight for a tradeable permit program depends partially on the scope of the program, the options included, and the monitoring and transaction costs. If the government chose to sell its allowances at auction, rather than given them away (as is typical), the government would have revenue like a carbon tax to recycle or readdress perceived distortions in the current tax code. In June 2000, CBO released

a study on the distributional effects of carbon trading programs. It concludes that if the government gave away carbon allowances to U.S. firms (as is typical for trading programs), the effects are regressive on households. If the allowances are sold at auction, the distributional effects would depend on the ultimate disposition of the revenue received from the sale. However, the carbon tax analysis does suggest that the price of a permit (and any revenues from the sale thereof) would be difficult to estimate with any precision at the current time.

The specific effects of both a carbon tax and tradeable permit program would depend on the specific levy (carbon tax) or allocation scheme (tradeable permit) chosen. Experience with both tax code revisions and the allocation scheme under the new acid rain title suggests that regional, state, and sector-specific concerns could receive special treatment in these decisions. In addition, for a carbon tax, the allocation of revenue received could also be influenced by such concerns.

Equity

The climate change issue and CO2 control raise numerous equity issues. In one sense, the concern about climate change is a concern about intergenerational equity—i.e., the well-being of the current generation versus generations to come. On a global level, the issue also involves the North-South debate. Some industrialized Northern countries suggest that the lesser-developed Southern countries refrain from certain activities (such as clearing rain forests) that Southern countries feel are important for their economic growth. Southern countries often suggest that the Northern countries change their current unsustainable growth practices and assist the South in sustainable development. Some supporters of tradeable permits have suggested that internationalization of the permit program could allow the wealthy countries to fund CO2-reducing activities (preserving forest, improving efficiency, etc.) as a means of achieving cost-effective reductions and assisting developing countries (i.e., joint implementation). However, as noted above, monitoring the long-term efficacy of JI projects raises administrative issues. Some carbon tax proponents have suggested that a portion of collected revenue could be set aside for assisting developing countries. Percentages to be set aside and more generally the political acceptability of such a proposal are unclear.

Other equity questions include the regional distribution of costs under a tradeable permit or carbon tax scheme. For example, an important impact of either a carbon tax based on the carbon content of fossil fuels or a tradeable permit program would be the pressure for fuel shifts away from coal and toward gas. (For a review of this impact, see CRS Report 91-883 ENR, *Coal Market Impacts of CO2 Control Strategies as Embodied in H.R. 1086 and H.R. 2663*.) Other regions, such as fast growing areas in need of more energy and owners of "all electric" homes, among others, would likely be disproportionately hit by a CO2 control scheme. In addition, people may be affected differently according to income class. These issues have not been sufficiently analyzed at the current time to draw firm conclusions.

Legislation in the 107th Congress

In the 107th Congress, three bills have been introduced to control CO2 emissions. S. 556, introduced by Senator Jeffords, and H.R. 1256, introduced by Representative Waxman would reduce and cap emissions of carbon dioxide from electric generating facilities beginning in 2007. For S. 556 and H.R. 1256, a cap of 1.914 billion tons would have affected all electric generating facilities rated at 15 megawatts (Mw) or higher. The third bill, H.R. 1335, introduced by Representative Allen, would also reduce and cap emissions of carbon dioxide from electric generating facilities at 1.914 billion tons. However, unlike S. 556 and H.R. 1256, would affect generating facilities rate at 50 Mw or higher, and has a compliance deadline of 2005. For all three bills, EPA is authorized to include market-oriented mechanisms, such as emissions trading, to implement the reduction targets.

Other Proposals

United States and International Activities

In March 2001, the Bush Administration announced that the Kyoto Protocol was "dead" as far as it was considered. In rejecting the Kyoto Protocol as unfair to the United States, EPA Administrator Whitman emphasized the Administration's desire to work constructively with the EC to develop technologies, market-based incentives, and other innovative approaches to global climate change. However, the Administration has yet to announce or outline any policy alternatives as a basis for international discussions.

Administration Domestic Initiatives

In late September 2000, Presidential candidate George W. Bush proposed a national energy plan that would include requiring utilities to reduce their carbon dioxide emission over a "reasonable" time frame in a manner similar to the current market-based acid rain reduction program. Few specifics, such as reduction targets or schedule, were included in the plan. In March 2001, the Bush Administration reversed its campaign position, stating that it will not seek legislation to reduce CO2 emissions. In making the reversal, the Administration cited a DOE study indicating that energy costs would increased if controls were put on CO2 emissions.

In February, 2002, the Administration initiated a new voluntary greenhouse gas program, similar to ones introduced by the earlier Bush and Clinton Administrations. Developed in response to the U.S. ratification of the 1992 UNFCCC, these previous plans projected U.S. compliance, or near compliance, with the UNFCCC goal of stabilizing greenhouse gas emissions at their 1990 levels by the year 2000 through voluntary measures. The new proposal introduced by the Bush Administration does not make that claim, only projecting a 100 million metric ton reduction in emissions from what would occur otherwise in the year 2012. Instead, the plan focuses on improving the carbon efficiency of the economy, reducing current emissions of 183 metric tons per million dollars of GDP to 151 metric tons per million dollars of GDP in 2010. It proposes several voluntary initiatives, along with increased spending and tax incentives, to achieve this goal.

However, the Administration projects that three-quarters of this reduction would be achieved through current efforts underway, not by the new initiatives.

Based on the Administration's estimates, the initiative will result in U.S. greenhouse gas emissions being 28% above 1990 levels in the year 2010, a 4.5% reduction over a business-as-usual baseline.