CONGRESSIONAL BUDGET OFFICE
U.S. Congress
Washington, DC 20515

March 13, 2006

Honorable Jeff Bingaman
Ranking Member
Committee on Energy and Natural Resources
United States Senate
Washington, D.C. 20510

Dear Senator:

In response to a request from your staff, the Congressional Budget Office provided comments on the white paper *Design Elements of a Mandatory Market-Based Greenhouse Gas Regulatory System*, which you and Senator Domenici issued in February 2006.

The details of CBO's response are in the attachment to this letter. If you have any questions or need further information, please feel free to call me at (202) 226-2700 or Terry Dinan, the staff contact for this work, at (202) 226-2940.

Sincerely,

Donald B. Marron

Donald B. Marron
Acting Director

Attachment

cc: Honorable Pete V. Domenici
Chairman

Comments on *Design Elements of a Mandatory Market-Based Greenhouse Gas Regulatory System*

In light of concerns that rising concentrations of greenhouse gases in the atmosphere may be affecting the Earth's climate, several Members of Congress and public interest groups have proposed plans to require cuts in the United States' emissions of those gases. Implementing a "cap-and-trade" program is an example of one such proposal. Under such a program, policymakers would establish an overall cap on emissions but allow regulated firms to trade rights to those emissions, called allowances. That trading would provide an incentive for firms that could reduce their emissions most cheaply to sell some of their allowances to firms that faced higher costs to reduce their emissions. Such an approach would help reduce the costs of achieving the emissions cap.

In an effort to lay out some of the key questions and design elements of a national greenhouse gas program, Senators Pete Domenici and Jeff Bingaman in February 2006 issued a white paper, *Design Elements of a Mandatory Market-Based Greenhouse Gas Regulatory System.* That paper asks four questions:

(1) Who is regulated and where?

(2) Should the costs of regulation be mitigated for any sector of the economy, through the allocation of allowances without cost? Or, should allowances be distributed by means of an auction? If allowances are allocated, what is the criteria for and method of such allocations?

(3) Should a U.S. system be designed to eventually allow for trading with other greenhouse gas cap-and-trade systems around the world, such as the Canadian Large Final Emitter system or the European Union emissions trading system?

(4) If a key element of the proposed U.S. system is to 'encourage comparable action by other nations that are major trading partners and key contributors to global emissions,' should the design concepts of the National Commission on Energy Policy plan (i.e., to take some actions and then to make further steps contingent on the review of what these other nations do) be part of a mandatory market-based program? If so, how?

Further, the white paper solicits comments on any additional topic related to the design of a mandatory market-based program. The Congressional Budget Office (CBO) has issued several papers that address issues raised in the white paper.[1]

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1. See Congressional Budget Office, *Who Gains and Who Pays Under Carbon-Allowance Trading? The Distributional Effects of Alternative Policy Designs* (June 2000); *An Evaluation of Cap-and-Trade Programs for Reducing U.S. Carbon Emissions* (June 2001); *The Economics of Climate Change: A Primer* (April 2003); *The Economic Costs of Reducing Emissions of Greenhouse Gases:*

In summary, if policymakers decide to limit emissions of carbon dioxide, the primary greenhouse gas, through a cap-and-trade program, they face a choice about where in the production process to implement the regulation. An "upstream" cap would offer two significant advantages and one potential disadvantage over a "downstream" cap:

- An upstream cap would create economywide incentives for households and businesses to reduce their consumption of carbon-intensive goods and services. As a result, it would reduce emissions at a lower cost than if the cap (and resulting incentives for reduction) had been restricted to one downstream sector, such as the electricity sector.

- The costs and complexity of implementing an upstream cap, which would require regulating a limited number of suppliers of fossil fuels, would be significantly less than that of a comprehensive downstream system, which could potentially entail regulating millions of emitters.

- An upstream cap may not provide an incentive to adopt post-combustion technologies that facilitate the capture and sequestration of carbon emissions. Such an incentive could be created by a downstream system that determined allowance requirements on the basis of monitored emissions. An upstream system could provide incentives for sequestration if firms were allowed to meet their allowance requirements by paying for downstream sequestration.

Capping greenhouse gas emissions would impose costs throughout the economy: entities would pay for those costs in the form of higher prices, reduced profits, and lower wages. At the same time, the pool of allowances would have substantial value to those who hold them. Policymakers would need to decide whether to sell the allowances to regulated firms, to give them away, or to implement a combination of the two.

Selling allowances rather than giving them away would not increase the overall economic costs of the cap-and-trade program but would provide an opportunity to use the allowance revenue to reduce other economic distortions. For example, policymakers could use the new source of revenue to reduce existing taxes that tend to slow economic growth (that is, taxes on productive inputs such as capital and labor); to decrease the federal debt; or to fund other government objectives (which otherwise would rely on taxes on productive inputs). As a result, the level of economic activity could be higher if policymakers sold some of the allowances than if they allocated them all at no cost.

A Survey of Economic Models (May 2003); *Uncertainty in Analyzing Climate Change: Policy Implications* (January 2005); and *Limiting Carbon Dioxide Emissions: Prices Versus Caps* (March 15, 2005).

Alternatively, policymakers could give some allowances (at no cost) to select firms or individuals to offset the costs that they would incur under the new regulations. Decisions about compensation are complicated by several factors:

- Determining who bears the costs of the cap is difficult. Regardless of whether allowances are sold or given away, the costs of the cap are distributed throughout the economy based on underlying supply and demand conditions.

- Decisions about allocating allowances can increase the overall costs of achieving the cap if they are linked to decisions that influence current emissions. Basing decisions about allowance allocations on historic amounts of production, consumption, or emissions would avoid that problem.

- The costs of the cap would extend beyond firms and consumers to the federal government. Provided that policymakers wanted the government to at least break even under the cap, they would need to reserve a share of the allowances to offset the government's program-induced costs.

- Workers in carbon-intensive industries, such as coal, cement, or aluminum, would be adversely affected if the cap reduced production of those goods. Allocating allowances (at no cost) to firms in affected industries would be likely to benefit the firms' shareholders but not the firms' workers.

Finally, the inclusion of a safety valve, or limit on the maximum price, in the cap-and-trade program could help keep the economic costs of the program in line with the expected benefits of reducing emissions.

The remainder of this paper is in the format requested by the authors of the white paper in their call for comments. Each of the four questions has several clarifying questions. The three relevant issues that CBO addresses and the related clarifying questions posed in the white paper are all stated at the top of the page in italics, and CBO's responses follow. The paper concludes with CBO's response to the solicitation for comments on additional design topics.

Issue 1: *Who is Regulated and Where?*

Specific clarifying questions raised in the white paper:

> *Is the objective of building a fair, simple, and rational greenhouse gas program best served by an economy-wide approach, or by limiting the program to a few sectors of the economy?*
>
> *What is the most effective place in the chain of activities to regulate greenhouse gas emissions, both from the perspective of administrative simplicity and program effectiveness?*

Deciding where in the production process it would be most effective to place the cap would depend on the particular greenhouse gas in question. The following discussion applies to carbon dioxide, the primary greenhouse gas.[2] An "upstream cap" would limit the amount of fossil fuels introduced into the economy; in contrast, a "downstream cap" would place the cap closer to the point where those fuels are combusted and emissions are released. As discussed below, an upstream cap would be expected to be more cost-effective—that is, it would be more likely to achieve any given amount of emission reductions at a lower cost than a downstream cap.[3]

The advantages offered by an upstream cap are twofold. First, it would entail regulating a relatively small number of entities. Second, it would create economywide incentives to reduce the amount of fossil fuel consumed. Thus, it would provide an incentive to cut carbon emissions where they can be reduced most cheaply. (Providing incentives to reduce fossil fuels is equivalent to providing incentives to reduce carbon emissions with one exception—it does not provide an incentive to adopt post-combustion technologies that facilitate the capture of carbon emissions for sequestration. That is discussed in more detail below.)

The economywide incentives for reducing carbon emissions under an upstream design stem from the price increases that would result from limiting the production of fossil fuels. Carbon is a component of fossil fuels. It enters the economy when those fuels are imported or produced domestically and is emitted when they are burned. Under an upstream program, the producers and importers

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2. In 2004, carbon dioxide from energy combustion accounted for 82.4 percent of greenhouse gas emissions in the United States (measured in carbon dioxide equivalents). See the Energy Information Administration's annual reports on U.S. greenhouse gas emissions at www.eia.doe.gov/oiaf/1605/1605aold.html.

3. For a more detailed discussion of the pros and cons of an upstream versus a downstream design, see Congressional Budget Office, *An Evaluation of Cap-and-Trade Programs for Reducing U.S. Carbon Emissions* (June 2001).

of fossil fuels would be required to hold allowances based on the carbon content of their fuel—that is, the carbon emitted when the fuel is combusted.[4] An upstream cap on carbon emissions would limit production of carbon-based fossil fuels and would cause the price of those fuels to rise—with price increases reflecting each fuel's allowance requirements and, hence, its carbon content.

The increases in fossil fuel prices that would result from the upstream cap would raise firms' and households' costs, encouraging them to decrease their consumption of fossil fuels and energy-intensive goods and services. (For example, households might drive less, and utilities might replace coal with lower-carbon-emitting fuels, such as natural gas or renewable sources of energy.) As a result, households and businesses throughout the economy would have an incentive to reduce all forms of carbon consumption and thus carbon emissions. That equal incentive—throughout the entire economy—would help limit the costs associated with achieving any given level of emission reductions. Further, the higher fossil fuel prices that would result from the cap would provide an incentive for firms to conduct research that could lead to innovations that would reduce fossil fuel use—for example, improvements in energy efficiency and renewable energy sources. Because the price increases would be economywide under an upstream cap-and-trade program, the incentives for innovation would be economywide as well, covering transportation, electricity generation, and industrial processes. As such, an upstream cap-and-trade program could encourage research and development on a wide range of carbon-reducing technologies.

An attempt to achieve economywide incentives for reducing carbon emissions under a downstream cap-and-trade program would probably entail much higher implementation costs. The costs of implementing an upstream program are held down because there is a limited number of producers and importers of fossil fuels and because their allowance requirements could be determined on the basis of information about the amount and type of fuel that they sold in the United States.[5] In contrast, a comprehensive downstream system could entail regulating many more entities. The further downstream the allowance requirement is placed, the larger the number of entities that would need to be regulated. Ultimately, carbon

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4. To avoid making the cap place U.S. exports of fossil fuels at a disadvantage, fossil fuels that were exported could be exempt from the cap. Regulating importers and exempting exporters would have the effect of restricting the emissions associated with U.S. consumption (not production) of fossil fuels.

5. The Center for Clean Air Policy estimated that an upstream program would require less than 2,000 entities to hold allowances. See Center for Clean Air Policy, *U.S. Carbon Emissions Trading: Description of an Upstream Approach* (Washington, D.C.: Center for Clean Air Policy, March 1988), p. 7.

is emitted by roughly 380,000 industrial establishments, millions of commercial buildings, and hundreds of millions of homes and automobiles.[6]

Although an economywide approach to reducing emissions would probably be more cost-effective, the administrative costs of implementing a downstream cap-and-trade program could be reduced if the cap covered only a limited number of sectors. Roughly 40 percent of carbon dioxide emissions stem from the combustion of coal and natural gas to generate electricity; 32 percent result from the combustion of transportation fuels, such as gasoline and diesel; and the remaining 28 percent stem from the combustion of coal, oil, or natural gas directly by the residential, commercial, or industrial sectors.[7]

Some legislative proposals would have limited a carbon cap to the electricity sector. Limiting the cap to the electricity sector would greatly reduce implementation costs relative to a comprehensive downstream cap; however, it would have several disadvantages relative to an upstream cap. First, a downstream system that was limited to electricity generators would confine incentives for cutting carbon emissions—and for innovation—to that sector, even if potentially lower-cost reductions could have been obtained from sources outside that sector. For example, such a cap would not encourage emission reductions that stem from transportation or from fossil fuel uses in industrial and commercial sectors not associated with their purchase of electricity from covered generators. Second, a downstream cap would offer less certainty than an upstream cap that any desired reduction in U.S. emissions would be achieved. Because the cap would restrict emissions in only one sector, emissions in other sectors could continue to grow. Further, to the extent that electricity generation could shift among establishments to avoid the cap, the system could create leakage. For example, if the program was designed to cover emitters above a certain size (in order to limit the number of regulated entities and to hold down the administrative costs of the program), more electricity generation could shift to facilities that were smaller than the cutoff size.

Although moving the allowance requirement downstream is likely to either increase the costs of implementing the program (if a downstream program was comprehensive) or decrease the cost-effectiveness of the emission reductions that were achieved (if the downstream program was limited to specific sectors), it could offer one advantage relative to an upstream design: it could provide incentives for the use of post-combustion technologies designed to capture carbon emissions for sequestration (that is, long-term storage). That incentive would be achieved if the downstream system regulated actual emissions from sources rather

6. Ibid., p. 5.

7. See www.eia.doe.gov/emeu/aer/txt/ptb1202.html.

than approximating their emissions on the basis of the fuels that they consume. For example, a cap on emissions from the electricity sector would provide generators with an incentive to install technologies that would scrub emissions from their smokestacks. Those emissions could then be sequestered. (For example, researchers are exploring the feasibility of sequestering carbon emissions in abandoned oil wells and in the ocean.) Alternatively, upstream cap-and-trade programs could be designed to provide incentives for such carbon capture and sequestration if upstream firms were allowed to meet some fraction of their allowance requirement by paying for the capture and sequestration of carbon. (As discussed under clarifying question 2d, those provisions could allow for biological sequestration as well.)

Issue 2: *Should the costs of regulation be mitigated for any sector of the economy, through the allocation of allowances without cost? Or, should allowances be distributed by means of an auction? If allowances are allocated, what is the criteria for and method of such allocations?*

A general discussion of each of these three questions is provided here. The observations made here apply generally to all of the clarifying questions (about allocations for specific purposes) that follow. Only details that pertain to particular clarifying questions are added under the clarifying questions that begin with 2a: Technology R&D and Incentives.

Should the costs of regulation be mitigated for any sector of the economy, through the allocation of allowances without cost?

Restricting carbon emissions through a cap-and-trade program would probably be costly. As a result, discussions about such a program often include a consideration of whether entities that would bear a particularly large share of that cost would be compensated. (When examining the pros and cons of providing compensation, CBO assumes that decisions about the stringency of the cap would be made independently of decisions about compensation—that is, providing compensation would not be linked to a more stringent cap.) One method of compensating adversely affected entities would be to give them allowances at no cost. Unfortunately, identifying which entities are likely to bear the costs of the cap is difficult. Households, firms, nonprofit organizations, and government agencies all contribute to emissions of carbon dioxide and other greenhouse gases, and all would bear some share of the costs associated with restricting emissions.

Knowing where the cap is placed—that is, which firms would actually be required to hold allowances—provides little insight into who would actually bear the costs of the cap. That is because the costs of the cap do not stick to the point where it is placed; rather, the actual costs of restricting emissions are distributed throughout the entire economy. The extent to which the costs of the cap would be passed forward on to the ultimate consumers of goods and services (such as households and businesses that consume gasoline and electricity) or backward on to fossil fuel suppliers (such as coal producers and oil importers) would depend on the underlying supply and demand conditions for those products. In sum, decisions about which entities might receive compensation are complicated by the difficult task of determining where the actual costs of the cap would land. Decisions about compensation are unrelated to the decision about where the cap is actually placed because the distribution of the costs of the cap does not depend on the latter decision.

How would allocating allowances at no cost provide compensation? Because a cap-and-trade program would limit the quantity of carbon emissions that are allowed, the right to emit carbon (that is, the allowances) would be valuable.

Depending on how stringent the cap is (and thus how valuable the allowances are), that value could be quite large.[8] Policymakers could give entities (for example, households, electric utilities, or coal producers) a share of the allowances to compensate them for the higher costs that they would incur as a result of the cap. Those entities could sell the allowances (to the firms that would be required to hold them) or use them to meet their own allowance requirement (if they are regulated).

Although providing allowances at no cost could compensate some entities, the value of the allowances is going to fall short of the costs that all affected entities combined incur as a result of the cap.[9] As such, policymakers would not be able to offset all firms, households, workers, nonprofits, and government agencies for the costs that they would incur. A decision to provide more compensation to some set of entities would inevitably reduce the compensation that could be offered to others.

Compensation could offset the initial costs of the cap for some entities, but it would not alter the initial distribution of the costs of the cap throughout the economy—that is, it would not alter the ultimate price changes that would result from the cap.[10] For example, providing allowances at no cost to coal producers would not lead to lower coal prices. Thus, compensating coal producers would not protect coal-fired electricity producers, or their customers, from the higher prices that they would be likely to face as a result of the cap. Because compensating entities that are required to hold allowances would probably not affect the price increases that would result from the cap, decisions about compensation would not alter the effect that the policy might have on the competitiveness of U.S. goods.

Difficulties in identifying who actually bears the costs of the cap mean that the government could unintentionally undercompensate or overcompensate various entities. For example, the distributional effects of a cap-and-trade program on electricity producers and consumers would depend on a variety of factors, including the degree of competition in the electricity market, the method of allowance allocation (discussed below), and the mix of generation assets (for

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8. For example, U.S. entities released rough 7 billion metric tons of greenhouse gases (measured in carbon dioxide equivalents) in 2004. Valued at $7 per ton (the safety-valve price used in the National Commission on Energy Policy report *Ending the Energy Stalemate: A Bipartisan Strategy for Meeting America's Energy Challenges*), the value of those emissions would be $49 billion.

9. The costs of the policy would include the costs of the allowances themselves (equivalent to the allowance value) and the substitution costs—that is, the costs that entities would bear from reducing their consumption of fossil fuels.

10. Some exceptions to this are if allowances are granted as a function of current production or if allowances are given to utilities whose electricity prices are set by regulators. Those exceptions are discussed in more detail in the following sections.

example, coal, natural gas, nuclear, and hydro). Effects on an individual utility will differ from effects on the electricity sector as a whole depending on whether it sells power in a regulated or competitive power region, its particular mix of generation assets, and whether the individual entity was in existence when the policy went into effect.[11] Some utilities would be better off, and some would be worse off. Because it is difficult to determine the costs that any given utility would actually bear as a result of the cap, it is also difficult to determine the degree of compensation required to offset those costs, and hence, overcompensation is a possibility.

When examining who actually bears the costs of the cap and considering the possibility of providing compensation, policymakers could consider the costs that the cap would impose on the government. If policymakers wanted the government to at least break even as a result of the cap-and-trade program, they would need to reserve a share of the allowances to offset the costs that the cap itself could impose on the government.[12] Those potential costs stem from several sources. First, governments are consumers of energy and energy-related services.[13] As such, they would bear a share of the costs of a cap-and-trade program that led to higher energy prices. Second, to the extent that the policy reduced economic activity (for example, the gross domestic product), government tax receipts would be reduced.[14] Third, government expenditures for transfer payments linked to price indexes (such as Social Security payments) would increase as a result of policy-induced price increases.

Should allowances by distributed by means of an auction?

As an alternative to distributing allowances without cost, policymakers could sell some, or all, of the allowances. Doing so would provide policymakers with a new

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11. For a discussion of those factors, see Dallas Burtraw and others, "The Effect on Asset Values of the Allocation of Carbon Dioxide Emission Allowances," *The Electricity Journal*, vol. 15., no. 5 (Washington, D.C.: Resources for the Future, March 2002).

12. This discussion does not include the costs of actually implementing the cap-and-trade program.

13. The government is estimated to have consumed roughly 13 percent of carbon consumed in the United States in 1998. See Congressional Budget Office, *Who Gains and Who Pays Under Carbon-Allowance Trading? The Distributional Effects of Alternative Policy Designs* (June 2000), p. 11.

14. In contrast, to the extent that the allowance distribution led to increases in shareholders profits, a fraction of that increase would be received by federal, state, and local governments through collections in taxes on profits. For a discussion of the distributional effects that different allocation decisions would have, see Congressional Budget Office, *Who Gains and Who Pays Under Carbon-Allowance Trading?* and Terry M. Dinan and Diane Lim Rogers, "Distributional Effects of Carbon Allowance Trading: How Government Decisions Determine Winners and Losers," *National Tax Journal*, vol. 55, no. 2 (June 2002), p. 206.

source of revenue that could be used to reduce reliance on existing sources of revenue that tend to reduce economic activity.[15]

Most sources of government revenue create unwanted effects—that is, they discourage productive activity. For example, taxes on labor, capital, or income (a combination of the returns to labor and capital) tend to reduce incentives to work and to invest.[16] Selling the allowances would provide a new source of revenue that could be used for a variety of purposes, including reducing existing taxes on productive inputs (such as capital and labor), decreasing the federal debt, or funding other government objectives (which otherwise would rely on taxes on productive inputs).

Thus, although selling allowances (as opposed to giving them away) would not have a direct influence on the costs of the cap, it would create an opportunity for policymakers to use the allowance value to reduce costs associated with unrelated spending or taxation programs.[17] The ultimate economic impact of selling allowances would depend on how policymakers used the allowance revenue. If policymakers gave the revenue back to regulated entities in a lump-sum fashion (not related to their use of capital or labor or their current level of production), the overall economic effect would be equivalent to a program in which they gave allowances to producers at no cost.

Even if the initial allowances (corresponding to the amount of emissions allowed under the cap) were allocated at no cost, the inclusion of a "safety valve" in a cap-and-trade program could result in the government selling additional allowances. The safety valve would establish an upper limit on the price of allowances. If the price of allowances rose to the safety-valve price, the government would sell as many allowances as was necessary to maintain that price. The amount of allowances sold under such a program would depend on the difference between the stringency of the cap and the safety-valve price. A stringent cap with a low safety-valve price could cause regulated entities to buy a substantial number of allowances.

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15. Higher energy prices created by the cap would tend to slow economic growth as well. However, those price increases would occur regardless of whether the government sold the allowances or gave them away.

16. Higher prices created by a cap on emissions would reduce real income from working and investing and, thus, the incentive to do so. Such reductions in inputs to production would exacerbate the discouraging effect that existing taxes on labor and capital already have on productive activity. The exacerbation of existing tax distortions—called the tax-interaction effect—is difficult to measure but could be significant. However, the magnitude of the tax-interaction effect is likely to be the same whether allowances are sold or given away.

17. For a discussion of the distributional implications of alternative allocation schemes, see Congressional Budget Office, *An Evaluation of Cap-and-Trade Programs for Reducing U.S. Carbon Emissions*.

If allowances are allocated, what is the criteria for and method of such allocation?

Two alternative methods of allocating allowances to firms are "output-based allocations," which link allocations to current production decisions, and "grandfathering," which bases allocations on historic emissions or production decisions. In general, analysts find that grandfathering would result in lower costs than output-based allocations. That is because output-based allocations distort production decisions in ways that increase the costs of obtaining a given level of emission reductions. This issue is discussed in more detail in clarifying question 2f.

Clarifying Questions 2a:

Technology R&D and Incentives

- *What level of resources should be devoted to stimulating technology innovation and early deployment?*

- *What portion, if any, of the revenues from permits or the auction of allowances should be reserved for technology development? If some portion is reserved for this purpose, should that set-aside flow to the federal government with funds spent through the traditional appropriation process? Or should the funds be allocated directly to a non-profit research consortium, chartered by the federal government, which would then administer technology development and deployment projects? Or should there be some combination of these two options?*

- *What criteria should be used to determine how such funds are spent and which projects are chosen?*

- *What other mechanisms should be used to promote technology deployment? Options include tax credits, cost-sharing for demonstration projects, assistance to state energy programs, etc.*

Technological advances could play an important role in reducing greenhouse gases at an affordable cost. A cap-and-trade program would provide incentives for firms to invest in developing new technologies; however, firms may not be able to reap the full benefits from those investments. As a result, firms' investments may fall short of the amount that would occur if all of the resulting benefits were taken into account. That shortfall may provide a justification for federal subsidies for R&D.

A cap-and-trade program would place an implicit price on carbon emissions, raising the costs of producing and consuming goods that generate those emissions. The higher prices created by those caps make it profitable for firms to develop technologies that could reduce the costs of cutting carbon emissions.[18] Those innovations could include improvements in energy efficiency or improvements in alternative energy technologies, such as solar, wind, or hydrogen. (Incentives for sequestering carbon would be created only if firms were

18. In the absence of an explicit incentive to reduce carbon emissions, firms' incentives to reduce fossil fuel consumption (and associated carbon emissions) would stem from other market forces, such as the rising price of oil due to underlying conditions in supply and demand. Firms' investments in energy efficiency or alternative energy technologies, however, would fall short of the amount that would occur if they had an incentive to take the benefits of reducing carbon emissions into account.

allowed to meet their allowance requirement by engaging in sequestration activities.) Thus, a cap-and-trade program is appropriately viewed as stimulating private R&D on carbon-reducing technologies.

The magnitude of the incentives for R&D would depend on the stringency of the cap over time. A cap that was implemented for a short period of time would create less incentive for investment in the development of new technologies than one that was expected to persist well into the future. In addition, the more stringent the initial cap was, or future caps were expected to be, the greater would be the incentives for R&D. Because decisions about investing in developing new technologies depend primarily on the future market for those technologies (when the R&D investments would bear fruit), expectations about future caps are of primary importance.

In general, research and development for all technologies (including carbon-reducing technologies) create "spillover benefits"— benefits that society as a whole would receive as a result of a firm's R&D effort but that the firm would be unlikely to capture in the form of higher profits. For example, the development of a new technology may result in general knowledge that is useful in many ways but is not directly covered by a patent. Similarly, one innovation may inspire subsequent innovations that are not tied closely enough to the initial innovation that they are covered by the patent. As a result of those spillover benefits, the profit motive may provide firms with too little incentive to invest in R&D. Existing general tax credits for R&D expenses and current funding of low-carbon energy sources, such as solar, nuclear, and wind, provide some additional incentives to at least partially account for those spillover benefits.

Supplementing private R&D efforts with federal funds would involve both costs and benefits. It would be efficient to the extent that the amount of private R&D stimulated by a cap-and-trade program would fall short of the amount that would occur if all benefits were taken into account. The ultimate efficiency of federal funding would, in turn, depend on the design of the federal funding initiatives (such as investment tax credits, targeted funding of specific technologies, or the offering of federal prizes for technological breakthroughs). The potential costs of federal R&D efforts include the cost of raising funds, the cost of efforts that are ultimately unsuccessful, and the extent to which federally funded R&D on carbon-reducing investments would crowd out other forms of R&D. Thus, it is possible to invest either too much or too little in federal R&D.

The existence of spillover benefits creates an economic rationale for subsidizing R&D on carbon-reducing technologies. However, there is no economic reason to link decisions about funding R&D to the revenues that might be generated by selling allowances under a cap-and-trade program. As described in the general discussion above regarding allocation decisions, the revenue from selling allowances could be used for a variety of different purposes that would have different overall effects on the economy. Likewise, decisions about funding R&D

for carbon-reducing technologies could be considered on the basis of their own merit.

Clarifying Questions 2b:

Adaptation Assistance

- *What portion of the overall allowance pool should be dedicated to adaptation research or adaptation-related activities?*

- *How should these allowances or funds be administered?*

- *What is the appropriate division between federal vs. regional, state, and local initiatives?*

In light of the potential for future changes in climate, even if emissions were severely restricted, adaptation could play an important role in any effective climate strategy.[19] The appropriate funding for adaptation could be considered on its own merits—there is no economic reason to link it to the existence of a cap-and-trade program, to link it to the value of allowances created by a cap-and-trade program, or to fund it out of allowance revenues.

19. See Congressional Budget Office, *Uncertainty in Analyzing Climate Change: Policy Implications* (January 2005), p. 36.

Clarifying Questions 2c:

Consumer Protections

- *What portion of the allowance pool should be reserved to assist consumers?*

- *Should funds from the sale of permits or allowances be targeted primarily to low-income consumers, or should they be more widely distributed to benefit all consumers?*

A cap-and-trade program is likely to result in higher prices for energy and energy-intensive goods and services as the costs of the carbon restriction are passed on to the ultimate consumers of the products whose consumption results in carbon emissions. Those higher prices play an important role in inducing the behavioral changes that would ultimately reduce emissions, such as using more energy-efficient appliances and purchasing more fuel-efficient cars. At the same time, those higher prices will impose financial costs on consumers. The costs that individual consumers would bear would depend on the amount, and the mix, of goods that they buy. In general, higher-income households would bear more costs (measured in dollar amounts) simply because they consume more goods. Measured as a share of household income, however, the higher prices would impose a larger burden on lower-income households because lower-income households tend to consume a larger proportion of their income.[20]

20. See Congressional Budget Office, *Who Gains and Who Pays Under Carbon-Allowance Trading?*, p. 21, table 4.

Clarifying Questions 2d:

> *What portion of the allowance pool should be reserved for the early reduction credit program and the offset pilot program?*
>
> *Are other set-aside programs needed?*

Early Reduction Credits:

A program for reporting voluntary reductions in greenhouse gas emissions has been in effect since 1994. Over 2.5 billion metric tons of emission reductions (measured in carbon dioxide equivalent tons) have been reported under that program in the 1994-2004 time period.[21] The extent to which firms would benefit from those early reductions would depend, in part, on whether allowances were sold. If allowances were sold, early reducers would receive some benefit from their actions because those reductions would decrease the number of allowances that they would need to purchase once the cap was in effect.

If allowances were distributed without cost, then the extent to which firms would benefit from early reductions would depend on whether policymakers allowed them to receive credits for their early reductions (or for a fraction of them). Issuing credits for early reductions would shift costs from companies that engaged in early reductions to ones that did not (provided that the overall cap was unaffected by the amount of early reductions made). Free allowances to early reducers would decrease the number of allowances that could be distributed to other firms. As a result, firms that did not make early reductions would bear a larger share of the costs of meeting the limit on emissions once the cap was in place.

The shift in the cost burden away from firms that received early-reduction credits could be problematic if those credits were earned for reductions that the firms would have found it profitable to make anyway, regardless of regulatory incentives. In that case, companies would receive credit for such reductions, even though they would not have decreased emissions relative to the level that would have occurred without an early-reduction program.[22]

Offsets:

Policymakers would need to decide whether to build incentives for sequestration into a cap-and-trade program. A trading program that calculated allowance

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21. To provide perspective, U.S. emissions of greenhouse gases in 2004 are estimated at approximately 7 billion metric tons.

22. For a discussion of early-reduction crediting, see Congressional Budget Office, *An Evaluation of Cap-and-Trade Programs for Reducing U.S. Carbon Emissions*, pp. 14-15.

requirements on the basis of the carbon content of the fossil fuel used, produced, or sold by a firm would not provide incentives for any form of sequestration. Thus, an upstream program would not provide such incentives. A downstream program could provide some incentives for sequestration, but only if allowance requirements were based on actual emissions. For example, consider a downstream trading program that required electricity generators to obtain allowances. That trading program could provide incentives for installing scrubbers that would capture and sequester carbon emissions, but only if generators' allowance requirements were based on their actual emissions. No such incentive would exist if allowance requirements were estimated on the basis of generators' fuel consumption.

Although a downstream program in which allowance requirements were based on actual emissions could provide incentives for some forms of sequestration, it would not provide incentives for other forms. For example, it would not provide any incentive for firms to offset their emissions with biological sequestration (such as growing trees). Policymakers could build in incentives for biological sequestration by allowing firms to meet some fraction of their allowance requirement by funding such initiatives. Although such sequestration projects could offer low-cost carbon reductions, they could also add considerably to the program's complexity and implementation costs because measuring, monitoring, and enforcing sequestration projects would be difficult.

Clarifying Questions 2e:

Special considerations for fossil-fuel producers?

- *Would some upstream fossil fuel producers be unable to pass the cost of purchasing permits or allowances through in fuel prices if they are the regulated entity?*

- *Is there a sufficient policy rationale for addressing these costs to justify the complexity of setting up and administering an allocation system for these entities?*

- *What other options exist to address the inability of fossil fuel producers to pass through these costs?*

Carbon emissions result from the combustion of fossil fuels, with some fuels leading to greater carbon emissions than others. For example, the amount of carbon released per million British thermal units (Btus) of coal is 1.8 times the amount released per million Btus of natural gas. Differences in the carbon content among fuels mean that some fossil fuel producers and suppliers could be better off as a result of the cap-and-trade program whereas others could be worse off. For example, natural gas producers could be better off if the policy caused electricity generators to switch from carbon-intensive coal to relatively less carbon-intensive natural gas. As a result, the natural gas industry could potentially experience increased profits and higher wages under an initial adjustment period. In contrast, the policy would probably decrease the demand for coal. Therefore, that industry could experience lower profits, decreased wages, and lost jobs, particularly as the industry adjusts to lower output levels. Assuming that allowances were granted on the basis of historic factors (such as a firm's previous production), the granting of allowances would not affect firms' future marginal costs or future production decisions. As a result, compensation provided to firms would be likely to benefit shareholders (it would be equivalent to a windfall gain) but would not be likely to reduce the costs borne by workers because it would not offset the decrease in production that the cap would induce.

The costs that fossil fuel producers would bear as a result of the cap would depend on underlying supply and demand conditions, not on whether they were the regulated entity—that is, required to hold allowances (this point is explained in more detail in the general observations following question 2). As such, the decision about whether to compensate fossil fuel producers (shareholders) or workers need not depend on whether they were the regulated entity.

Clarifying Questions 2f:

Allocations for downstream electric generators?

- *Should electricity generators be included in the allocation if they are not regulated? (Clarification: We mean to ask if an electric generator should be included in the allocation if the greenhouse gas regulation occurs at a point of regulation that is upstream or downstream from the generator, but not the generator itself.)*

- *What portion of the total allocation should be granted to the electric power sector? Should it be based on the industry's share of greenhouse gas emissions or some other factor?*

- *Should generators in competitive and cost-of -service markets be treated differently under an allocation scheme?*

- *How should permits or allowances be distributed within the electric sector? Should it be based on historic emissions? Electricity output? Heat input?*

As observed in the general discussion following question 2 above, the costs that entities would bear under a cap-and-trade program generally depend on the underlying conditions of supply and demand, not on whether those entities are required to obtain allowances for their emissions. As a result, decisions about whether to compensate electricity generators need not be linked to decisions about whether the allowance requirement is placed on them or upstream or downstream of them.

However, provided that policymakers decided to place the allowance requirement on electricity generators, there could be a reason why selling allowances to generators in cost-of-service markets would be more efficient than issuing them at no cost. In most cases, regulators include inputs at their "original cost" (actual prices paid for them) when calculating electricity prices.[23] As a result, allowances that generators receive at no cost would not lead to higher electricity prices in cost-of-service markets. (In competitive markets, that would not be the case because firms would reflect the opportunity cost of using the allowance—that is, the forgone revenue from not selling it—in the prices that they charge for electricity.) Failure to pass the opportunity cost of using allowances on to electricity customers, however, would provide consumers in cost-of-service markets with an insufficient incentive to reduce their use of electricity. As a result, allocating allowances at no cost to electricity generators in cost-of-service

23. See Dallas Burtraw and others, "The Effect on Asset Values of the Allocation of Carbon Dioxide Emission Allowances," pp. 51-62.

markets could increase the cost of reducing emissions, and auctioning allowances to generators in those markets would be more efficient.

The cap-and-trade program could impose higher costs on electricity generators, particularly those that burn coal. Those generators, however, are likely to pass much of those costs on to their customers in the form of higher prices (as discussed above, this is particularly likely in electricity markets with a high degree of competition). As a result, matching the industry's share of allowances to its share of greenhouse gas emissions would probably overcompensate generators because much of the cost of the cap would be passed on to electricity consumers.

The costs that an individual utility would bear would depend on whether it sells power in a regulated or competitive power region, its particular mix of generation assets, and whether it was in existence when the policy went into effect. Some utilities would be better off, and some would be worse off.[24] Efforts to match compensation to actual costs would have to take those factors into account.

Basing allocations on current production decisions (called output-based allocations) rather than on historic emissions or production decisions (called grandfathering) could increase the overall costs of meeting an emissions cap. A cap-and-trade program would be most effective at reducing the costs of attaining an emissions cap if the trading program provided equal incentives for businesses and households to engage in all forms of carbon-reducing activities: it should not provide greater incentives for some activities than for others. Provided that electricity is sold in a competitive market, a cap-and-trade program in which allowances (or a share of them) were grandfathered to existing firms would meet that condition, whereas a program in which allowances (or a share of them) were allocated to firms on the basis of their current production would not.

Allocations that were linked to historic emissions or production decisions would not affect electricity producers' future production decisions or future electricity prices. Thus, the costs associated with emitting carbon would be passed on to the firms and households that use electricity, providing them with an incentive to limit their use. In contrast, output-based allocations would link a producer's allowance allocation to its current production decisions. Thus, the costs of producing a unit of electricity would be subsidized by the allowances earned as a result of the additional production. As a result, output-based allocations would tend to encourage more electricity production and lower electricity prices. Lower electricity prices, in turn, would mean that the policy would not give firms and households as much incentive to limit their electricity use. Although output-based allocations could lower the costs that the cap-and-trade program would impose on electricity consumers, it would increase the overall costs of the program. Higher-

24. For a discussion of those factors, see Burtraw and others,"The Effect on Asset Values of the Allocation of Carbon Dioxide Emission Allowances."

cost emission reductions in other sectors would need to make up for the increased emissions (relative to grandfathering) in the electricity sector.[25]

25. For a more detailed discussion of grandfathering versus output-based allocations, see Congressional Budget Office, *An Evaluation of Cap-and-Trade Programs for Reducing U.S. Carbon Emissions.* Also see Dallas Burtraw and others, *The Effects of Allowance Allocation and the Cost of Efficiency of Carbon Emission Trading* (Washington, D.C.: Resources for the Future, April 2001).

Clarifying Questions 2g:

Allocations for energy-intensive industries?

- *Is there a sufficient policy rationale to have an allocation to selected energy-intensive industries? What industries should be included in the allocation?*

- *What portion of the overall allocation framework should be reserved for these industries?*

- *What are the appropriate metrics for determining allocations across different industries?*

A restriction on carbon emissions would lead to higher energy prices and thus would impose costs on energy-intensive industries such as steel, aluminum, chemicals, pulp and paper, and cement. Higher production costs for those industries would tend to decrease their competitiveness, particularly if the prices for their goods were determined in world markets (where higher production costs could not be passed on to consumers in the form of higher prices). As a result of those higher production costs, production levels, profits, and wages in those industries could decline.

Giving allowances to firms in energy-intensive industries could compensate shareholders for the reduction in profits. However, assuming that allowances were granted on the basis of historic factors (such as a firm's previous production), such allowances would not offset any reduction in the competitiveness of those industries because they would not lower the costs of producing the energy-intensive goods.[26] Correspondingly, giving allowances would not offset the costs that workers in those industries might bear as a result of the decrease in production.

26. The results would be different if the number of allowances that firms received was directly linked to their current, or future, production decisions (referred to as "output-based" allocations). In that case, firms would "earn" allowances on the basis of their production decisions—and the decline in production that would result from the cap could be less. As described in the discussion under clarifying question 2f, however, such output-based allocations would be inefficient—that is, they would increase the costs of obtaining any given amount of carbon reductions.

Clarifying Questions 2h:

Allocations to other industries/entities?

- *What other industries/entities (e.g. agriculture, small businesses, etc.) allowances considered in the allocation pool?*

- *What should be the basis for their share of the total allocation as well as for the distinction among such industries/entities?*

The Congressional Budget Office has not written about this issue in the past and, as a result, has not offered a response to these questions.

Issue 3: *Should a U.S. system be designed to eventually allow for trading with other greenhouse gas cap-and-trade systems around the world, such as the Canadian Large Final Emitter system or the European Union emissions trading system?*

Clarifying questions raised in white paper:

- *Do the potential benefits of leaving the door open to linkage outweigh the potential difficulties?*

- *If linkage is desirable, what would the process for deciding whether and how to link to systems in other countries?*

- *What sort of institutions or coordination would be required between linked systems?*

Because emissions from anywhere in the world make the same potential contribution to warming, a mitigation program would minimize the costs of meeting any particular goal by placing the same price on emissions everywhere. Thus, if policymakers were to adopt cost-effectiveness as a guiding principle in controlling emissions, they would want to ensure that emission prices would be equalized across countries. One way to accomplish that goal would be to allow for the trading of emission credits or rights across international borders.

Nevertheless, international trading could raise or lower the domestic price of emissions and the overall costs of the domestic program, depending on what set of countries was included in the system and the relative stringency of participating countries' domestic programs. For example, if trading only involved developed countries, each with an emission target that required similarly proportionate reductions in baseline emissions, emissions trading would be likely to raise prices in the United States, benefiting owners of domestic emission credits but hurting fuel users. In contrast, if a trading system included developing countries such as India and China, and those countries had targets consistent with their projected baseline emissions, emissions trading could result in a dramatic decrease in the emission price in the United States.[27]

Further complications would arise if cap-and-trade systems in different countries had dramatically different rules. Significant variations among systems would be likely to significantly increase monitoring and enforcement costs. Even more complications in monitoring and enforcement would arise if a domestic trading system allowed for regulated entities to earn credits by sponsoring emission-reducing projects in countries that did not have any targets at all. Further, countries' ability to ensure that their emission target would be met could be

27. See Congressional Budget Office, *The Economic Costs of Reducing Emissions of Greenhouse Gases: A Survey of Economic Models* (May 2003), p. 82.

limited if any participating country's system incorporated a safety valve, or limit on the maximum price, and if regulated entities in other countries were allowed access to credits available at the safety-valve price. For example, if the clearing price for emission allowances necessary to meet the cap in the European Union trading program was higher than a safety-valve price included in a U.S. trading program, then European firms could comply by purchasing U.S. allowances. If that was to occur, the emissions cap in the EU program would not be met.

If there is an additional topic related to the design of a mandatory market based program that you would like to address, please submit comments on this form.

A cap-and-trade program for carbon dioxide emissions would offer a way to set an overall limit on the level of carbon dioxide emissions while relying on economic incentives to determine where and how emission reductions occur. Such a program would probably reduce the costs of meeting an emission-reduction target, but it would not necessarily balance actual costs with the expected benefits achieved by the target. As described below, including a "safety valve" in a cap-and-trade program could help achieve that goal.

A cap-and-trade program with a safety valve would combine an overall cap on total emissions with a ceiling on the allowance price. If the price of allowances rose to the ceiling (or safety-valve) price, the government would sell as many allowances as was necessary to maintain that price. Thus, if the safety valve was triggered, the actual level of emissions would exceed the cap. The cap would be met only if the price of allowances never rose above the safety-valve price.

If policymakers had complete and accurate information on both the costs and benefits of achieving various limits on emissions, the inclusion of a safety valve would not offer any economic advantages. With full information, policymakers could set the cap to the level at which the cost of the last ton of emissions reduced in order to meet the cap was equal to the benefit from that reduction. However, neither the costs nor the benefits are known with certainty. For that reason, the best policymakers can do is to choose the policy instrument that is most likely to reduce the cost of making a "wrong" choice. Choosing a cap that is too stringent would result in excess costs that are not justified by their benefits. The inclusion of a safety valve that limited the price of allowances to the expected benefits of incremental emission reductions would avoid that outcome.

The advantages of including a safety valve in a cap-and-trade program stem mainly from the fact that the cost of limiting a ton of emissions is expected to rise as the cap becomes more stringent, whereas the expected benefit of each ton of carbon dioxide reduced is roughly constant across the range of potential emission reductions in a given year.[28] Because the additional benefit created by each additional ton of carbon that is reduced as the cap is tightened is expected to remain constant (even though it cannot be known with certainty), yet the additional cost is expected to rise by an unknown amount, a safety valve could

28. That constancy occurs because climate effects are driven by the total amount of carbon dioxide in the atmosphere, and emissions in any given year are a small portion of that total. Further, reductions in any given year probably would be considerably less than the total baseline emissions for that year.

help prevent excess costs. A safety valve would limit the cost of additional emission reductions to the expected benefit of those emission reductions.[29]

29. Limiting emissions of carbon dioxide with a tax on carbon emissions (set equal to the expected benefit of reducing emissions by one ton) could offer additional economic advantages over a cap-and-trade program with a safety valve. If the costs of reducing emissions were greater than expected, the tax would perform in the same manner as the safety valve. However, if the costs of reducing emissions were less than expected (and thus, the cap was less stringent than might have been justified by actual costs and benefits), the tax could offer additional advantages. The tax could motivate more emission reductions than would have been required by the cap—keeping the cost of emission reductions in line with the benefits that they were expected to create. Available research indicates that a price instrument, such as a tax or safety valve, would offer economic advantages over a cap as long as policymakers did not feel it necessary to make extremely large emission reductions in the near term to avoid passing a threshold level of atmospheric concentration—that is, a point at which incremental increases in emissions would lead to a large increase in the incremental damages caused by those emissions. For a more detailed description of the advantages that a tax and a safety valve offer, along with an illustrative example, see Congressional Budget Office, *Limiting Carbon Dioxide Emissions: Prices Verus Caps* (March 15, 2005).