Assessing the Financial Consequences to Firms and Households of a Downstream Cap-and-Trade Program to Reduce U.S. Greenhouse Gas Emissions*

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Introduction and Overview

United States policies to reduce carbon dioxide ("CO_2") and other greenhouse gas ("GHG") emissions could have substantial effects on U.S. firms and households.[1] This paper considers the financial effects of a downstream cap-and-trade approach to reducing CO_2 emissions[2], concentrating on the effects of the following three key elements:

1. ***Initial allocations.*** The approach used to distribute initial allocations of the capped total would have major effects on the financial consequences to sectors and firms. In some circumstances, the initial allocation approach also could affect the overall cost-effectiveness and other efficiency considerations of the program.

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2. ***Product market conditions.*** The ultimate effects of a cap-and-trade program on sectors and households also depend upon the extent to which GHG-related costs – including the opportunity cost of using CO_2 allowances to cover emissions – can be passed on to consumers in the form of higher prices (or backward to energy suppliers in the form of lower fuel prices).
3. ***International CO_2 allowance prices.*** Overall financial impacts of a U.S. CO_2 program could be substantially reduced if U.S. firms were able to obtain lower-priced CO_2 allowances abroad. Although most firms would gain financially as buyers, impacts would be more complicated for firms that would be net sellers under a U.S.-only scheme.

II. Initial Allocation

Perhaps no issue has been more contentious in the existing cap-and-trade programs than the allocation of initial allowances. The initial allocation of allowances in a cap-and-trade program confirms valuable property rights and thus it is not surprising that there are considerable differences among participants in recommendations for the appropriate distribution of the allowances. Moreover, in some circumstances the initial allocation approach could affect the overall costs of the program or other "efficiency" considerations. Before discussing the implications of alternative allocation approaches, it is useful to provide a context by considering how a firm would operate under a cap-and-trade program.

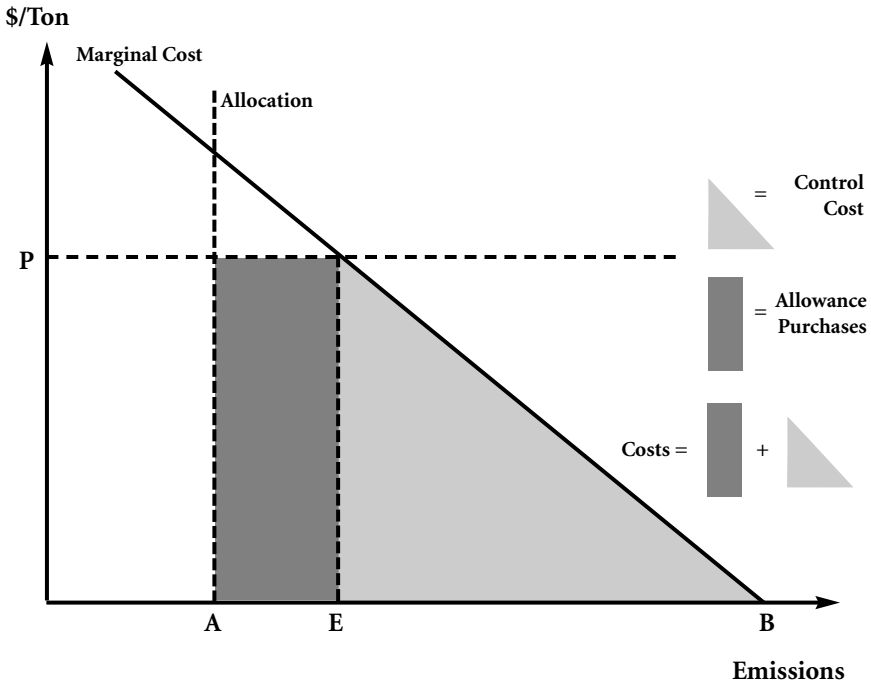
A. Factors Affecting the (Initial) Financial Effects to a Firm of Participating in a CO_2 Allowance Market

Creating a cap-and-trade program for CO_2 (or GHG) emissions means that firms will be participating in a new market – the market for CO_2 allowances. The financial consequences depend largely upon whether a firm is a buyer or a seller of CO_2 allowances, which depends in part on its allocation but also on other factors.

Figure 1 illustrates how a given firm (e.g., oil refinery, electric utility) would be affected by participating in a CO_2 market under a cap-and-trade program. The figure shows the five factors that influence the net costs that the company would bear initially in the CO_2 permit market. (As discussed below, the ultimate effects depend upon how these costs are reflected in product prices.)

- ***Baseline emissions (B).*** This is the level of emissions that the firm's facilities emit under so-called "business-as-usual" (BAU) circumstances, i.e., without limits on CO_2 emissions.
- ***Marginal cost curve.*** This is the curve that shows the marginal cost of reducing the firm's CO_2 emissions (e.g., improving efficiency, substituting low-CO_2 fuels).
- ***Permit price (P).*** This is the expected permit price that the firm would expect to pay (or receive) in the CO_2 allowance market.
- ***Controlled emissions (E).*** This is the level of the firm's emissions after taking into account its optimum controls, i.e., reductions that would cost less than the allowance price. (Note that this optimum depends only on the marginal cost curve and the permit price.)
- ***Allocation (A).*** This is the total number of CO_2 allowances initially allocated by the government to the firm. Note that where all allowances are auctioned, the initial allocation would be zero.

FIGURE 1: ILLUSTRATION OF FACTORS AFFECTING THE FINANCIAL IMPACTS OF A FIRM'S PARTICIPATING IN A CO_2 EMISSIONS MARKET



There are two major implications for financial impacts that follow from these market conditions. First, the *control costs* that the firm would incur do *not* depend upon the allocation; the firm's control costs depend upon its marginal cost curve (i.e., its cost of internal reductions in CO_2 emissions) and the CO_2 permit price. Second, the firm's allocation largely determines whether it will be a buyer or a seller (and how much it will buy or sell) and thus does have a major effect on the financial implications. This figure shows a case in which the allocation (A) is *less* than the firm's controlled emissions (E) and thus the firm *buys* allowance as part of its compliance with its allocated cap. (Note that an auction represents an extreme case in which all participants are buyers and thus all firms pay for allowances to cover *all* of their controlled emissions.)

The financial impacts on the firm would be different if the firm received an allocation (A) *greater* than its controlled emissions (E); in that case, the firm would be able to sell allowances and thus would gain from the CO_2 allowance sales. In essence, the firm would be in another business – the business of "producing" valuable CO_2 allowances. In this case, the net financial impacts of to the firm would be equal to the control costs it incurs minus the revenues it receives for selling its surplus CO_2 allowances.

B. Overview of Major Initial Allocation Approaches

Clearly the procedures used to allocate the total CO_2 cap would have a major effect on the financial consequences to individual sectors and firms. It is useful to distinguish the following three basic alternatives for initially allocating allowances:

1. ***Auction.*** This alternative would involve the U.S. Government auctioning the allowances initially.
2. ***Grandfather.***[3] Under this alternative, allocations would be provided to participants (or others) based upon historical information. For example, allocations to participants in the trading program could be based upon average emission levels in a recent (e.g., 1997–2002) period.
3. ***Update.*** This alternative involves allocating to participants or others based upon information that is updated over time. For example, allocations in 2015 might be based upon activity in 2010, allocations in 2016 based upon 2011 activity, and so on.

Within the second and third categories, there are many additional choices. There are three basic metrics for the allocations: (1) input-based (e.g., tons of fuel input); (2) output-based (e.g., kilowatt-hours of electricity production); and (3) emission-based (e.g., tonnes of CO_2 emissions). There also are choices regarding the years to use for the allocations (e.g., average of recent years, maximum value within recent years) and which sources receive allocations (e.g., only sources regulated under the cap, or those sources and their customers, suppliers, etc.).

Note that it would be possible to combine the various approaches and, indeed, to shift the mix over time. One possibility that has been widely discussed, for example, would be to begin with grandfathered allocations and then transition to a mix of grandfathered and auctioned allowances until at some later point all allowances would be auctioned.

C. General Effects of Alternative Initial Allocation Approaches

It is useful to group criteria for evaluating alternative allocation approaches into two major sets: (1) efficiency considerations, which relate to cost-effectiveness and other societal effects; and (2) distributional considerations, which relate to how different subgroups would be affected. Table 1 lists various elements within these two categories and summarizes qualitative evaluations of the three major alternative allocation approaches. The table includes circles that provide a five-level ranking from best (solid black) to worst (solid white). The following are conclusions from these evaluations.

1. Evaluations Based on Cost-Effectiveness and Other Efficiency Criteria

- Auctions and grandfathering provide the best incentives to minimize compliance costs – that is, they both encourage GHG goals to be met at least cost – assuming that the allowance market is competitive and that there are no pre-existing distortions in the product market.
- Although firms would be allocated allowances for free under grandfathering, the "opportunity cost" of the allowances (i.e., the fact that the allowance can be sold) means that the costs of emissions would be reflected appropriately in product market prices under either grandfathering or auctions.
- Updating is potentially less efficient than either auctioning or grandfathering. The costs of meeting the cap would be greater under updating because

updating both increases administrative (program management) costs and skews the market away from some potential low-cost GHG emissions-reduction measures. In addition, the incentives created by updating could distort product market prices by keeping them "artificially" low, i.e., not reflecting the full costs of "using" allowances.

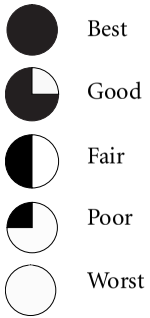
- Although neither auctions nor grandfathering generally would create "distortions" in product markets, if the product market were distorted by pre-existing policies—for example, if electricity prices were determined by cost-of service ratemaking rather than competitive markets—grandfathering would not necessarily result in minimizing compliance costs because the proper price signals might not necessarily be set.
- The efficiency gains from "recycling" (i.e., using) auction revenues depend upon whether the revenues are used to reduce existing taxes, or instead used to provide transitional assistance to displaced workers or other worthy causes (or simply distributed directly to households as an "environmental dividend")[4].
- The transactions costs of trading generally would not be affected by the choice of allocation approach. Assuming the allocations are clear—and thus participants know their allocation in advance—whether CO_2 allowances are auctioned, grandfathered or distributed with some updating procedure would not affect the costs of buying and selling.

2. ***Evaluations Based on Distributional Effects***

The three alternatives would have very different distributional effects.

- Auctioning is likely to harm participating sectors and provides no "stranded cost" relief to producers, unless revenues are recycled directly to the affected firms. On the other hand, auctions tend to be relatively good for consumers and taxpayers, assuming the revenues are recycled in a way that reduces other forms of taxation.
- Grandfathering helps sectors and provides "stranded cost" relief to producers, but is relatively bad for the sectors' consumers and provides no taxpayer gains.
- Updating is less attractive to controlled sectors than grandfathering because it leads to greater compliance costs and lower price increases than grandfathering. (This price effect is explored in the following section on product market effects.) The sector's consumers could benefit, however, due to the lower price increases.

Table 1: Comparison of Initial Allocation Alternatives



Allocation Alternative	Efficiency					Distributional			
	Compliance Costs	*Administrative Costs*	*Transaction Costs*	*Product Market Distortions*	*Tax Distortions*	*Sector Burden*	*Stranded Costs*	*Consumer/ Labor Effects*	*Taxpayer Effects*
1 Auction[1]	Best	Good	Good	Best	Best	Worst	Worst	Good	Best
2 Grandfathering[2]	Best	Good	Good	Best	Poor	Best	Best	Poor	Worst
5 Updating	Worst	Poor	Good	Worst	Worst	Worst	Poor	Best	Worst

Notes:

1. Auction revenues are assumed to be recycled so as to reduce taxes and to reduce impacts on the affected labor force.
2. Sectors receiving grandfathered allocations are assumed to be competitive or fully deregulated (e.g. electricity is priced on the basis of marginal cost rather than average embedded cost) and thus that the opportunity costs of allowances are reflected in prices to customers. efficiency and distributional impacts would differ if this assumption were not met.

Source: Derived from David Harrison, Jr. and Daniel Radov, *Evaluation of Alternative Initial Allocation Mechanisms in a European Union Greenhouse Gas Emissions Allowance Trading Scheme*, prepared for DG Environment, European Commission, March 2002.

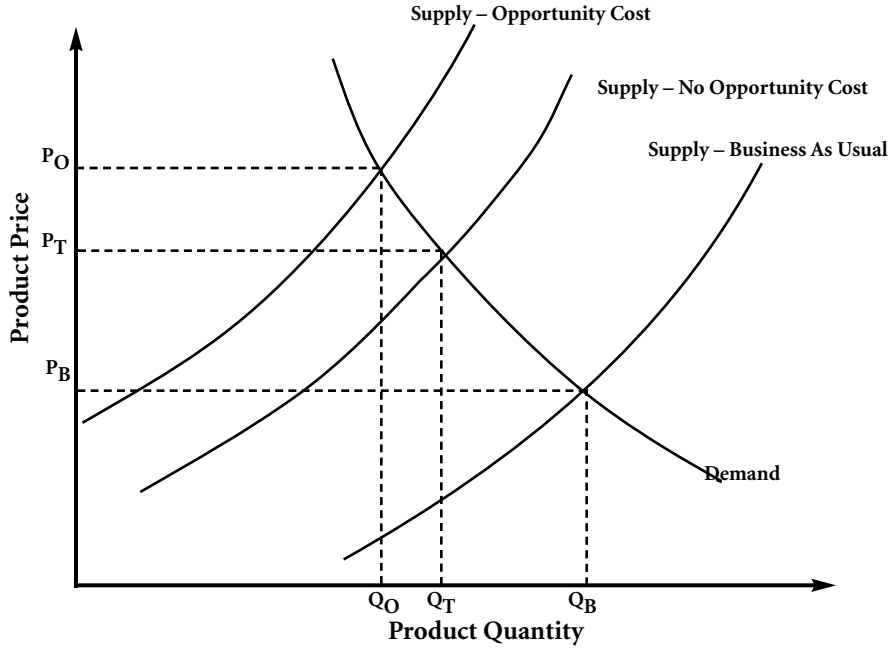
III. Product Market Conditions

The ultimate financial impacts of a U.S. CO_2 cap-and-trade program would also depend upon each firm's product market. In particular, firms and consumers would be affected by two major differences that might exist among product markets:

1. Whether the "opportunity costs" of allowances used to cover CO_2 emissions are reflected in product prices, i.e., passed on to consumers.
2. Whether firms operate in local/national markets, or in international markets largely unaffected by CO_2 concerns.

Figure 2 illustrates how financial impacts on firms and consumers would differ depending upon which cost elements of a CO_2 program would be reflected in product prices. The figure shows initial prices and output levels under "business as usual" conditions, i.e., conditions without a U.S. CO_2 program. Compliance costs to reduce CO_2 emissions will lead to cost increases, which in turn will be reflected in increases in product prices.

FIGURE 2: FINANCIAL EFFECTS FOR FIRMS OPERATING IN LOCAL/NATIONAL PRODUCT MARKETS



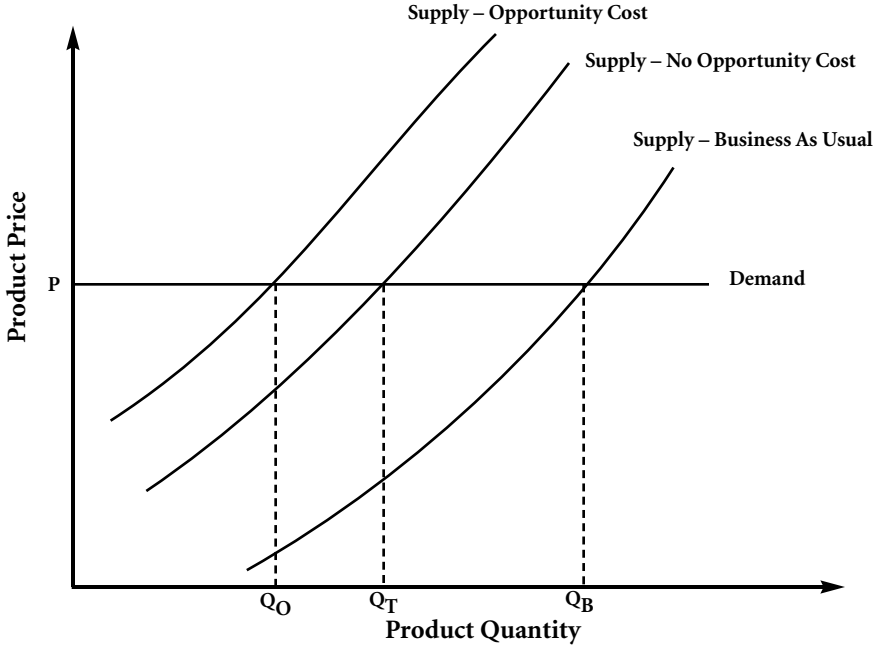
But prices would increase further if prices increase to reflect the fact that firms face a cost when they "use" allowances to cover their remaining CO_2 emissions. In the case of auctioned allowances, these costs are direct; but as noted above, the firm also incurs a cost for using allowances even if it receives the allowances for free. (These costs are referred to as "opportunity costs" because they reflect the opportunity to sell the allowances to other firms, rather than use them.)

Thus, the financial consequences of the CO_2 cap-and-trade program would be different for the firm's shareholders and its consumers depending whether prices reflect "opportunity costs." There are two cases in which the full opportunity costs may not be passed on to customers under a CO_2 cap-and-trade program:

1. ***Regulated prices with grandfathered allocations.*** Firms operating in regulated markets, in which prices are set on the basis of "cost-plus" considerations, may not experience price increases if the "opportunity cost" of grandfathered allowances are not included.
2. ***Updated allocations.*** Under an updating approach, if a firm expanded its output, it also would gain the right to a valuable asset (the right to receive a larger future CO_2 allocation). Thus, the firm would have an incentive to expand current output, resulting in lower product prices.

The financial consequences for firms and consumers also would be affected by the specific market conditions. Of particular interest are firms operating in global markets in which prices are set internationally and where competitors may not face a CO_2 price – examples could include crude oil markets, and to varying degrees the markets for paper, metals, non-metallic building materials and chemicals. In this case, global prices would not necessarily reflect CO_2 compliance costs or opportunity costs. Figure 3 shows the case of a firm operating in an international market with no ability to pass on added costs; in this case, the added costs of CO_2 controls (including the opportunity costs of the use of CO_2 allowances to cover its emissions) would lead only to reductions in output rather than increases in price.

FIGURE 3: FINANCIAL EFFECTS OF CO_2 PROGRAM FOR FIRMS OPERATING IN INTERNATIONAL PRODUCT MARKET



IV. International CO_2 Permit Prices

The financial effects of a U.S. cap-and-trade program would depend importantly on the ability of U.S. participants to trade allowances internationally. International prices for CO_2 allowances would provide an upper limit on the U.S. price – assuming CO_2 allowances in other countries could be purchased by U.S. firms – and thus would limit the overall cost of the program in the U.S. The financial impacts of a possible U.S. CO_2 program thus depend upon the likely international prices for CO_2 allowances, which are highly uncertain. Moreover, although U.S. firms would gain financially as CO_2 allowance buyers from low international prices, the financial effects could be more complicated for firms that would be sellers of CO_2 allowances or that would be recipients of gains from product price increases.

A. Factors Affecting International Prices for CO_2 Allowances

Many factors will influence the likely international CO_2 allowance prices that might be relevant for U.S. firms under a U.S. downstream cap-and-trade program for GHG. These factors include[5]:

- ***Prospects for an international permit market.*** There currently is no single international CO_2 market and there may well be constraints on U.S. participation in the CO_2 markets that are developing (most prominently the European Union Emissions Trading Scheme).[6]
- ***Effects of Russian "hot air" and strategic behavior.*** The Kyoto Protocol gives Russia a critical role with regard to likely international CO_2 prices. In addition to its importance in Kyoto's ratification, the decline in Russia's CO_2 emissions leaves it with substantial "hot air." Russia (and others similarly situated) may withhold CO_2 supply in order to drive the price of CO_2 allowances up.[7]
- ***Availability/cost of potential CDM and sink credits.*** The effective CO_2 price facing U.S. firms would depend upon the cost and availability of credits allowed for in the Kyoto Protocol, particularly the Clean Development Mechanism ("CDM") and sink enhancement.
- ***Level of U.S. cap.*** Given its importance as a source of CO_2 emissions, the level of the U.S. cap (or mandatory CO_2 commitment) will have an important influence on the international demand for CO_2 allowances, and thus on likely international CO_2 prices.

B. Financial Implications of International CO_2 Allowance Prices

Although it is clear that the overall cost of meeting a given U.S. CO_2 cap or commitment would be reduced if U.S. firms had access to potentially lower international CO_2 allowances, the financial impacts could be more complicated for some firms.

- ***Potential sellers under a U.S.-only program.*** Firms that would be net sellers of CO_2 allowances may lose financially if CO_2 prices are lower because of the availability of lower-priced international CO_2 allowances.
- ***Recipients of substantial product price increases.*** Firms that would gain from product price increases linked to CO_2 allowance prices may actually lose financially if CO_2 prices are lower due to lower-prices international CO_2 allowances.

V. Concluding Remarks

These various considerations suggest three general conclusions related to the financial aspects of a downstream cap-and-trade program for U.S. CO_2 and GHG emissions.

1. ***Details matter in assessing financial consequences.*** The financial impacts of such a program on a given firm (or household) will depend upon many specific elements – notably its initial allocation, its opportunities for reducing CO_2 from its facilities, and its opportunities for increasing prices that reflect CO_2 compliance and opportunity costs.
2. ***Most details affect distributional considerations.*** Most of the design elements of a U.S. cap-and-trade program for CO_2 emissions – other than the overall level of the cap – affect the distribution of costs among various groups, rather than the overall costs or administrative feasibility of the program.
3. ***Emissions trading is well suited for controlling CO_2 and other GHG emissions.*** If a decision were made to control U.S. CO_2 emissions, a downstream cap-and-trade program seems well suited as part of the overall program.[8] Such a program could be designed to achieve political feasibility while maximizing environmental effectiveness, cost-effectiveness, administrative feasibility and distributional equity.

Endnotes

1. This paper focuses on financial impacts on firms, because this is often the focus of concerns about political feasibility. Financial impacts on firms ultimately would be translated into impacts on households, both as shareholders and taxpayers (because of the corporate profits tax).

2. The focus on a downstream cap-and-trade approach is due to its prominence in recent policy analyses, including the excellent report that forms the focus for this policy dialog (Robert Nordhaus and Kyle Danish, *Designing a Mandatory Greenhouse Gas Reduction Program for the U.S.*, Pew Center for Global Climate Change, May 2003) and Congressional initiatives (e.g., Mc-Cain-Lieberman) as well as the forthcoming downstream cap-and-trade program being developed for the European Union, the European Union Emissions Trading Scheme ("EU ETS"). Note, however, that although this paper focuses on emissions trading, the framework to assess financial impacts that is developed here can also be applied to taxation approaches; indeed, there are many similarities between a tax approach and emissions trading where emissions allowances are auctioned. This paper draws on the

author's participation in the development of previous emissions trading programs as well as recent work related to the EU ETS, particularly the following documents: David Harrison and Daniel Radov, *Initial Allocation Options for a European Greenhouse Gas Emissions Cap-and-Trade Program*, prepared for the Environment Directorate, European Commission, March 2002; David Harrison, Daniel Radov, et al., *Alternatives for Implementing the UK's National Allocation Plan*, prepared for the UK Department of Environment, Food and Rural Affairs, August 2003.

3. The term "grandfathering" is used to mean the distribution of allowances for free based upon historical information, to distinguish it from the other two forms. Note, however, that "grandfathering" has different meanings in other papers and thus some have avoided its use, distinguishing "free" or "gratis" allocations and "updated" or "non-updated" allocations.

4. There is a rich literature on a possible "double dividend" from the use of auction revenues to reduce distorting taxes. See, for example, Lawrence Goulder, Ian Perry, Robert Williams and Dallas Burtraw, "The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a Second Best Setting." *Journal of Public Economics*, Vol. 72: 329-360 (1999).

5. Numerous studies consider likely CO_2 prices under various international regimes. For a comprehensive overview of studies evaluating likely prices under the Kyoto Protocol, see John Weyant and Jennifer Hill, "Introduction and Overview," in *The Costs of the Kyoto Protocol: A Multi-Model Evaluation, The Energy Journal, Special Issue*, 1999.

6. The European Union Emissions Trading Scheme ("EU ETS") creates a EU-wide cap-and-trade program for CO_2 emissions and eventually other greenhouse gas emissions. For a brief description of the EU ETS, see David Harrison and Daniel Radov, "Europe Warms to Emissions Trading," *NERA Energy Regulation Brief*, April 2002.

7. Russia's incentive to drive CO_2 prices up, however, would be offset by the adverse effects of higher CO_2 prices on world oil prices, and thus Russia's profits as a major supplier of oil.

8. See A. Denny Ellerman, Paul L. Joskow and David Harrison, Jr., *Emissions Trading in the U.S.: Experience, Lessons and Considerations for Greenhouse Gases*, prepared for the Pew Center on Global Climate Change, May 2003.