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From SO_2 to Greenhouse Gases

Trends and Events Shaping Future Emissions Trading Programs in the United States

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RESOURCES FOR THE FUTURE

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Abstract

Cap-and-trade programs have become widely accepted for the control of conventional air pollution in the United States. However, there is still no political consensus to use these programs to address greenhouse gases. Meanwhile, in the wake of the success of the U.S. SO_2 and NO_x trading programs, private companies, state governments, and the European Union are developing new trading programs or other initiatives that may set precedents for a future national U.S. greenhouse gas trading scheme. This paper summarizes the literature on the "lessons learned" from the SO_2 trading program for greenhouse gas trading, including lessons about the potential differences in design that may be necessary because of the different sources, science, mitigation options, and economics inherent in greenhouse gases. The paper discusses how the programs and initiatives mentioned above have been shaped by lessons from past trading programs and whether they are making changes to the SO_2 model to address greenhouse gases. Finally, the paper concludes with an assessment of the implications of these initiatives for a future U.S. national greenhouse gas trading program.

Key Words: climate change, emissions trading, European Union, U.S. states, corporate environmentalism

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Joseph Kruger*

1 Introduction

The success of the U.S. SO_2 trading program has led to worldwide interest in emissions trading. The program has become a model for policymakers in the United States and in other countries that are considering cap-and-trade programs to reduce emissions. Once a theoretical option discussed only by economists, emissions trading is now considered a mainstream policy instrument in the United States with bipartisan political support. Internationally, emissions trading is no longer considered a "crazy American idea." It is now a fundamental component of the international framework to address climate change. Even developing countries from Chile to China are beginning to consider emissions trading programs to control conventional pollutants (U.S. EPA 2004a).

Many articles and studies have examined the lessons learned from the SO_2 trading program for greenhouse gas (GHG) trading. At the same time, fundamental differences between the climate change issue and conventional air pollution problems have led a number of authors to argue that certain features of the SO_2 program should be modified to address climate change. Analysis of both the similarities and differences between SO_2 and greenhouse gases has also informed U.S. legislative and policy proposals.

While debate on the optimal design of greenhouse gas trading programs continues, there is still no consensus at the federal policymaking level on the need for a mandatory program. However, the successful experience with SO_2 trading has inspired other domestic and international initiatives. These initiatives are incorporating lessons from SO_2 trading as they anticipate and try to shape the future of greenhouse gas trading. For example, private companies are adopting voluntary targets and other initiatives, some of which are designed to influence

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future mandatory approaches. State governments in nine New England and Mid-Atlantic states are developing a regional greenhouse gas cap-and-trade program, which is designed to encourage certain elements of a national program. States are also developing emissions registries, which may have implications for the design of future national trading programs. Finally, the European Union has recently begun operation of the world's largest emissions trading program. As a "first mover" on emissions trading, the EU program could set precedents and develop new features that may have an impact on the ultimate design of both the international trading regime and any potential U.S. domestic program.

In this paper I will discuss the path from SO_2 to greenhouse gas trading from both a design and a political economy perspective. First, I will briefly summarize the literature on the "lessons learned" from the SO_2 trading program for greenhouse gas trading. This will include discussion of potential differences in design that may be necessary because of the different sources, science, mitigation options, and economics of the climate change issue. Next, I will discuss how the three initiatives mentioned above have been shaped by lessons from past trading programs and are making changes to the SO_2 model to address greenhouse gases. Finally, I will conclude with an assessment of the most likely impacts from these initiatives on a future U.S. federal greenhouse gas trading program.

2 SO_2 Trading: Lessons Learned

The SO_2 trading program has been widely studied, and there is an extensive literature examining various aspects of the program.[1] A subset of this literature has looked specifically at lessons that would apply to greenhouse gas trading.[2] In general, most authors view the SO_2 program as a successful experiment, proving that emissions trading can be an effective and efficient policy instrument. Many authors have noted that emissions trading is particularly well suited for greenhouse gases because it is uniformly mixed and does not require limitations on trading to limit "hot spots."

[1] For economic assessments of the SO_2 program see Ellerman et al. 2000, Carlson et al. 2000, and Burtraw and Palmer 2004. For an independent assessment of the benefits of the program, see Burtraw et al. 1999. U.S. EPA 2004b summarizes the environmental impacts of the program.

[2] See, for example, Stavins 1998, ELI 1997, Tietenberg 2003, and Ellerman 2005, and Burtraw et al. 2005.

Analysis of the SO_2 program also sheds light on specific design elements that would be desirable to apply to a future greenhouse gas trading program. For example, experience with the SO_2 trading program has shown significant benefits from the temporal flexibility provided by banking provisions (Burtraw and Palmer 2004, Stavins 2003, Ellerman et al. 2000).[3] Second, analysts have noted that allowance distribution, particularly the allocation of allowances at no cost to affected facilities, has been critical in gaining political acceptance for the emissions trading concept (Stavins 1998, Ellerman 2005). Third, authors have emphasized the importance of strong monitoring and enforcement provisions, including reasonably accurate emissions measurement, automatic excess emissions penalties that are not subject to appeal or waivers (Ellerman 2003, Swift 2001), and public access to emissions and trading data through the use of information technology and the Internet (Tietenberg 2003, Kruger et al. 2000). Finally, observers have lauded the hands-off design of the cap-and-trade model, in which regulators track emission results but don't interfere in company decisions on emissions reduction options or conduct case-by-case reviews of trades (Ellerman 2005)**.**

While there is general agreement that the SO_2 program "proves the concept" of emissions trading for a greenhouse gas program, there is also considerable discussion in the literature about modifications to the basic SO_2 model that would be needed for a greenhouse gas program. Although a full discussion of these differences is beyond the scope of this paper, these differences boil down into five types. First, analysts have noted that the ideal program for greenhouse gas trading would be economy-wide, rather than in specific sectors (e.g., electric power). This is because of the prevalence of CO_2 in virtually every economic sector and the efficiencies that arise by equalizing marginal costs across the entire economy. To facilitate an economy-wide system, these analysts have argued that CO_2 emissions should be regulated "upstream" (i.e., by producers or processors of fuel) rather than "downstream" (i.e., direct emitters such as power plants and industrial facilities) to capture the largest percentage of emissions and to encompass the fewest number of sources (Keeler 2002, Morgenstern 2005 forthcoming). [4]

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[3] In contrast, the lack of an adequate banking provision in the RECLAIM trading program in Southern California may have been at least partially responsible for extreme price volatility following high electricity demand in 2000. See Ellerman et al. 2003.

[4] A hybrid system with both upstream and downstream elements is also possible (ELI 1997, Hargrave 2000). See Baron and Bygrave 2002 for a discussion of the advantages and disadvantages of different points of obligation for holding allowances.

Second, a trading system should consider multiple greenhouse gases to capture the widest array of cost-effective sources.[5] For example, Reilly et al. (2003) find that inclusion of all six greenhouse gases regulated under the Kyoto agreements could provide increased emissions reduction at a lower cost.[6] Inclusion of multiple gases in Kyoto and other trading regimes is possible because of a system of global warming potential (GWP) factors, which have been adopted by the Intergovernmental Panel on Climate Change (IPCC). These GWP factors serve as an "exchange rate" to set equivalencies for the six gases regulated under the Kyoto agreement.

Third, because of the magnitude of the emission allowance assets involved, a greenhouse gas trading program should consider auctioning, rather than free distribution of allowances. For example, Cramton and Kerr (2002) describe a number of equity benefits from the auctioning of allowances, including providing a source of revenue that could potentially address inequities brought about by a carbon policy, creation of an equal opportunity for new entrants in the allowance market, and avoiding the potential for "windfall profits" that might accrue to emissions sources if allowances are allocated at no charge.[7] Goulder et al. (1999) and Dinan and Rogers (2002) found that recycling revenues from auctioned allowances could have economy-wide efficiency benefits if they are used to reduce certain types of taxes.

Fourth, some analysts have advocated additional mechanisms to limit price risks from a greenhouse gas trading system.[8] For example, Pizer (2002) proposes a "safety valve" mechanism that would mitigate price risks by allowing sources to purchase additional allowances at a set price if allowance prices rise to that level. Kolstad (2005 forthcoming) finds that intensity targets, i.e., targets that index emissions to GDP or production, can reduce uncertainties associated with the cost of emission reduction under uncertain economic growth levels. Advocates of these types of mechanisms argue that CO_2 prices may be more unpredictable than

[5] Stavins and Richards (2005) find that biologic carbon sequestration is also a cost-effective strategy that could be part of a climate mitigation regime.

[6] In cases where it may be difficult to measure total mass from these sources but relatively easy to measure emission reductions (e.g., reductions of methane from a landfill) these sources might be captured with project-level offset provisions rather than through inclusion in the cap-and-trade program (U.S. EPA 2003).

[7] Bovenberg and Goulder 2001, and Burtraw et al. 2002 find that allocating only a small portion of allowances at no cost can compensate industry for losses due to a carbon policy.

[8] Allowance banking can also serve this function by creating a cushion that will prevent price spikes and hedge uncertainty in allowance prices (Jacoby and Ellerman 2004). Jacoby and Ellerman (2004) also note that some environmental groups have opposed a safety valve because it creates less certainty about the quantity that will be emitted.

SO_2 prices because there are relatively few mitigation options for CO_2, and there are currently no cost-effective post-combustion controls.[9] Moreover, CO_2 is a "stock pollutant," which accumulates in the atmosphere over an extended period. There is therefore less concern over short-term increase of CO_2 as long as the overall trajectory of CO_2 emissions is downward over an extended period.

Finally, many analysts have advocated international trading of greenhouse gas allowances, given that the atmosphere is indifferent to the location of emission reductions. International trading provides opportunities to incorporate reductions from developing countries like China and India, where analysis shows some of the lowest cost emission reduction opportunities (Ellerman and Decaux 1998). This concept is fundamental to the Kyoto Protocol, which provides for international trading among parties and for the development of project-level offsets in developing countries (Tietenberg et al. 1999).

2.1 Legislative and Policy Proposals for Greenhouse Gas Trading

Many of the features discussed above have been incorporated into legislative and policy proposals for greenhouse gas trading programs. For example, the McCain-Lieberman Climate Stewardship Act (S. 139) would cover much of the economy and would address the transportation sector "upstream" by requiring oil refiners to hold allowances. The McCain-Lieberman bill allows for emissions offsets (including non-CO_2 and biologic sequestration projects) and contains provisions for international trading, as does a bill introduced by Senator Carper (S. 843) that addresses CO_2 and other emissions in the electric power sector. Finally, an economy-wide, upstream proposal by the National Commission on Energy Policy (NCEP) includes an intensity-based target and a price cap to limit price uncertainties (NCEP 2004).[10]

While debate continues on these policy proposals, there is still no consensus in Congress on the need for a mandatory program, and few believe that new legislation will be adopted quickly.[11] Meanwhile, the Bush administration has rejected a mandatory approach to climate

[9] In the longer term, there may be cost-effective technologies to remove and sequester CO_2 from combustion. See Newell and Anderson 2004.

[10] Senator Jeff Bingaman of New Mexico has reportedly developed draft legislation based on the NCEP proposal (Eilperin, 2005).

[11] Although the Senate has adopted a non-binding resolution calling for a mandatory market-based program to address greenhouse gases (Blum, 2005), no such resolution has been adopted by the House of Representatives.

change. Instead, the administration has emphasized the long-term development of "climate-friendly" technology and the improvement of energy intensity through the implementation of a suite of voluntary measures.[12]

Thus, the most direct road to a national program, i.e., new national legislation, appears to be blocked for now. Instead, a variety of other initiatives, all of which were influenced by past U.S. trading programs, are establishing "facts on the ground" that may set precedents for a future U.S. program. The following sections will explore these initiatives.

3 Voluntary Corporate Initiatives

Some companies have implemented strategies to prepare for what they believe is an inevitable carbon constraint. In part, these strategies are designed to mitigate the risks of future carbon legislation. However, some companies have also staked out positions that they hope will influence potential future mandatory programs. This section will:

- Summarize the literature on why companies may voluntarily take environmental actions;
- Review company efforts on climate change; and
- Discuss the implications of voluntary corporate actions on the design of a future greenhouse gas trading program.

3.1 Why Do Companies Take Voluntary Action?

There are a variety of reasons that corporations adopt voluntary environmental actions to address greenhouse gas emissions or other environmental issues. Some companies have attributed these actions to sustainable development goals or environmental stewardship policies (Margolick and Russell 2001). However, it is often difficult to separate these goals from economic motives (Kolk and Pinske 2004).

Less controversial is the notion that companies adopt voluntary initiatives to create financial value in one form or another. Lyon and Maxwell (2004) argue for a political economy

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[12] For a more detailed description of the Bush administration climate change plan, see http://www.whitehouse.gov/news/releases/2002/02/climatechange.html.

framework for understanding corporate voluntary environmental action. In particular, they note that corporations may act in a desire to pre-empt or influence future regulation.[13] For example, adopting environmental technologies or other strategies ahead of regulatory mandates can signal to regulators that these alternatives are practical or relatively cost effective (Lyon and Maxwell 2004). Reinhardt (1999) describes how this strategy was pursued in the chlorofluorocarbon (CFC) manufacturing industry before the adoption of the Montreal Protocol. In other cases, trade associations have sponsored codes of management practices, which are partly intended to forestall the imposition of government mandates. For example, Nash and Ehrenfeld (1996) describe the Responsible Care Program, a voluntary code of management practices set up by the U.S. chemical industry that was designed as a voluntary effort to forestall the imposition of mandatory regulations on chemical production.

3.2 Voluntary Corporate Targets

A recent study found that as many as many as 60 U.S. corporations have adopted corporate greenhouse gas emissions reduction targets (Hoffman 2005). Some of these companies have participated in one of several partnership programs run by government agencies or non-governmental organizations (see Table 1). Under many of these programs, companies develop a corporate greenhouse gas inventory and adopt an emission target.[14] Some of the partnership programs allow additional flexibility in meeting a target through the use of emissions trading or the purchase of greenhouse gas offsets.

Corporate voluntary targets and participation in initiatives run by NGOs or government may have several impacts on future trading programs. First, companies may gain expertise that may be useful in assessing the impact of various regulatory policies on their companies. Hoffman (2005) finds that some companies have adopted internal emissions trading schemes or

[13] There are also non-political motivations for voluntary corporate actions. Although a full discussion of these motivations is beyond the scope of this paper, drivers of voluntary action described in the literature include: (a) the desire to limit future regulatory risk (Margolick and Russell 2001); (b) the desire to reduce costs through practices that also have environmental benefits (Esty and Porter 1998); (c) desire to differentiate a company or its products on an environmental basis (Reinhardt 1998); and (d) the desire to enhance employee morale and motivation (Reinhardt 2000).

[14] These targets take different forms. Companies such as U.S. electric power generators American Electric Power and Energy have adopted absolute targets based on mass emissions corresponding to a base year (King et al. 2004). Other companies, such as Rio Tinto and IBM, have adopted intensity targets, under which they commit to surpass a benchmark of emissions or energy use per unit of production or sales (Margolick and Russell 2001).

greenhouse gas measurement programs to gain expertise that will help them influence future national or international policies. Both British Petroleum (Akhurst et al. 2003) and Shell (Margolick and Russell 2001) have cited this experience as helping them gain influence in the design of the UK and EU trading systems.

Second, some aspects of voluntary corporate targets have implications for how a company will be affected by a future greenhouse gas cap-and-trade program. For example, fast-growing companies may be favored by rate-based or intensity targets as opposed to absolute targets based on mass emissions. This type of target may also favor companies with low carbon intensities. The type of corporate obligation chosen could also be designed to establish a precedent for a specific allocation methodology, such as a methodology based on historic emissions, heat input, or production output. Similarly, the "baseline protection" offered by registries may imply that a future allowance distribution will be done based on historic emissions or an output based methodology rather than through an auction.

Finally, to the extent that corporate targets or baselines are measured from specific years, companies become invested in allocation methodologies or future targets that include these years. For example, in describing its voluntary commitment of a 5% reduction below 2000 levels, the electric power company Cinergy notes:

> "Besides the obvious commodity price risk implicit in our target, we also are bearing some risk that our efforts will not be counted within a future regulatory regime. If the baseline is established far in the future, man years beyond the year 2000, with a specific provision to disallow early reductions, we would find that we had implemented our program too early. We believe this is unlikely, though it remains a risk." (Cinergy 2004)[15]

3.2.1 Chicago Climate Exchange

The corporate initiative most directly influenced by the SO_2 trading experience and most open about influencing a future climate regime is the Chicago Climate Exchange (CCX). For more information on CCX and other programs see Table 1. Richard Sandor, the president of the CCX, has invoked the SO_2 experience as a model "for the design of key elements" of the program (Sandor 2002). One of the key program goals of CCX is to give companies experience

[15] Cinergy has recently announced a plan to merge with Duke Energy, which declared its support for a carbon tax in April 2005 (Borska 2005).

with the mechanics and methodologies that will be necessary for the greenhouse gas market. Sandor (2002) also emphasizes the goal of influencing future legislation, noting that “a variety of legislative proposals have provided further indication that participation in CCX will help position participants to intelligently influence and benefit from possible future regulations.” Similarly, an official from American Electric Power, a participant in CCX, has noted that one of the motivations for participation in the voluntary program is the company’s interest in the development and use of greenhouse gas offsets or “off-system” reductions (Braine 2004). A report by independent directors of AEP notes that the company’s participation in CCX and other voluntary efforts have given it important experience in the design of potential future regulatory programs. The report finds that

> “the company is particularly well positioned to build on this experience to advocate effectively in policy and regulatory forums for the most efficient program designs, not only for the environmental benefits, but also for the benefits to its customers over the long-term.” (AEP 2004)

4 State Initiatives

Over the past few years, there has been an explosion in state programs that address emissions from greenhouse gases (Rabe 2004, McKinstry 2004). These programs run the gamut from renewable energy portfolio standards in more than a dozen states to a proposed CO_2 emissions standard for automobiles in California. However, one of the most widespread categories of state activities are programs to measure, report, register, and, in some cases, trade greenhouse gas emissions. These programs raise questions about whether they will build intuitions and set precedents that are helpful or harmful to future national efforts. This section will examine the motivations behind these state programs and explore the challenges and opportunities they pose.

4.1 Why Do States Take Voluntary Action?

There is extensive literature debating the appropriate level of government to address environmental problems. Although a full discussion of these issues—usually referred to as Environmental Federalism—is beyond the scope of this paper, much of the debate centers on weighing consistency and competitiveness issues that might arise from different environmental standards in different jurisdictions against the benefits of more localized decision making on environmental issues (Oates 2001, Revesz 2001). Authors have also highlighted the influence that state governments in the United States have had on national policy by experimenting with innovative initiatives (Oates 2001, McKinstry 2004, Vogel et al. 2005).

Additional issues arise for state climate change policies because of the global nature of the problem. First, although states or regional governments may adopt emission reduction programs to address “their share” of the global problem, their efforts may be futile if other states or national governments avoid emission reductions. Similarly, the public within these states may be concerned that non-participating states are “free riders” who benefit from the actions of the participating areas without paying the costs (Kousky and Schneider 2003). Second, state actions raise the potential problem of “leakage” if mandatory requirements in one jurisdiction cause a shift in economic activity and emissions to another jurisdiction without mandatory requirements (Keeler 2004, Kruger and Pizer 2005). For example, limits on power plants emissions in one state or region may simply shift power generation to other regions of the country. Finally, Keeler (2004) notes that solutions developed at the state or local level may not create the institutions necessary for a robust national trading program.

Nevertheless, states have cited a number of reasons for developing greenhouse gas programs. Many of these reasons are relevant to the registry or emissions trading initiatives that have proliferated. First, some states have adopted programs to address public or other stakeholder concerns about the impacts of climate change (Rabe 2004). Second, states have expressed a desire to influence national policy or regulations in ways that benefit their companies or other stakeholders. For example, Rabe (2004) argues that some U.S. states enacted greenhouse gas policies to facilitate recognition of emission reductions by companies in the event of future national regulations. Finally, some states have developed these programs to spur innovative technologies, encourage economic development benefits, or create environmental co-benefits (Peterson 2004).

4.2 State Greenhouse Gas Trading Programs

4.2.1 Regional Greenhouse Gas Initiative (RGGI)

One of the most significant state climate programs is an effort by nine states in the northeastern and Mid-Atlantic United States that have joined together to develop a regional cap-and-trade program. This program, known as the Regional Greenhouse Gas Initiative (RGGI), was launched in April 2003 when New York Governor George Pataki sent a letter proposing a regional emissions trading program to fellow governors. Initially, the program will address carbon dioxide (CO_2) emissions from the electric power sector. However, the program may be expanded to include additional sectors and greenhouse gases (GHGs). Advocates of the RGGI approach argue that the program could serve as a model for a future national cap-and-trade program for GHGs.

Organizers of RGGI have noted that the program will build upon past models of successful trading programs.[16] Although this includes the SO_2 program, RGGI is perhaps more similar to the OTC NO_x budget program, which was itself highly influenced by the national SO_2 trading program (Kruger and Pizer 2004, WRI 2005). Both the OTC and RGGI programs depend upon an innovative collaboration between states that voluntarily adopt model rules that allow the states to have the compatible features necessary for an emissions trading program. Although many of the details of RGGI are still in flux, the fundamentals will likely be very similar to past trading programs in the electric power sector. However, the RGGI program may experiment with some additional features that may be useful for a future greenhouse gas emissions trading program. Some of these features are discussed below.

4.2.1.1 Emissions Allowance Distribution

The distribution of allowances is one of the most contentious issues faced by policymakers when they design a cap-and-trade program. Allowances are a valuable asset, and the distribution of this asset has significant implications. Even with a modest target, the value of allowances in a national greenhouse gas trading program could be an order of magnitude (or more) larger than the value of allowances in the SO_2 trading program. Thus, allowance distribution for a national program will raise significant equity issues. RGGI could offer the opportunity to try out features at the state or regional level, such as auctioning portions of the annual allocations or allocating some allowances directly to groups that are disproportionately affected by the costs of a cap-and-trade program. These types of approaches could be components of a future national program.

4.2.1.2 Development of an Effective Offset Program

Greenhouse gas offsets could be a particularly cost-effective way to reduce the costs of a mandatory greenhouse gas program. Unfortunately, there are no effective models for offset programs to draw upon. Although project-based emissions offset programs for conventional

[16] RGGI organizers have made building on past successful trading programs one of their “guiding principles.” See http://www.rggi.org/goals.htm.

pollutants have been around for many years, many of these programs have had limited effectiveness because of high transaction costs and uncertain environmental integrity (Swift 2002). More recently, the process set up to implement the Clean Development Mechanism, the Kyoto Protocols project-level offset provision, has been costly and cumbersome (Jepma 2005). If states could advance an environmentally credible model with low transaction costs, it would be a significant contribution to a future national program. To this end, there have been discussions by the RGGI staff working group and their stakeholders about developing performance standards and other objective criteria that would provide clear signals to investors about the types of projects that would be acceptable (Sherry 2004).

4.2.1.3 International Linkages

The launch of RGGI has sparked great interest in Europe, where, as will be discussed later, an even larger experiment with greenhouse gas trading began on January 1, 2005. There have been informal contacts between state officials and officials of the European Commission and European member states to share information on how the new European Union Emissions Trading System (EU ETS) is developing. Contacts between the EU and states may provide opportunities to explore a number of "linking issues" that will be useful for any future GHG program (Fontaine 2005). RGGI states are also considering whether to accept EU ETS allowances and Clean Development Mechanism credits (Sherry 2005).

4.2.2 West Coast Trading Initiatives

Three western states—California, Washington, and Oregon—have launched an initiative to develop a coordinated greenhouse gas reporting system (Rabe 2004, Pew Center 2004). These states have also indicated that they may consider a trading system. A staff report released in November 2004 recommended that the governors of the three states consider a regional market-based carbon allowance program (WCGGI 2004).

West Coast states may develop a different model for a cap-and-trade program than has been developed by RGGI. Concerns about addressing imports of power from outside the state have led some stakeholders to advocate design approaches that focus on the distribution of electric power rather than generation. For example, an advisory group to the governor of Oregon has recommended a tradable carbon content standard for power consumed in the state, which would take power imports into account. (Governors Advisory Group 2004). California is considering a proposal to allocate allowances to load-serving entities, which would be required to hold allowances to cover the emissions of the electric power they distribute (CCAP 2005).

4.2.3 Registries as a Building Block for Trading?

More than ten states have adopted or are in the process of adopting voluntary registries for greenhouse gas emissions (PPI 2003).[17] Registries are electronic databases that track emission reductions by companies or other organizations. Under some of these programs, companies report their corporate-wide emissions and establish a baseline against which future corporate emission reductions can be counted. In other registry programs, companies may simply report specific emission reduction actions without reporting their overall corporate-wide emissions. Voluntary registries have a number of benefits, including helping corporations understand the scope of their emissions and possible mitigation measures that they might take. Registries may also raise awareness of the climate change issue and highlight the actions of companies that are leaders in reducing their emissions.

Some analysts have touted voluntary registries as an important building block for a future mandatory emissions trading program (PPI 2003). However, several aspects of voluntary registries may complicate the development of a future emissions trading program. First, there is an inherent contradiction in voluntary registries because these programs must balance the desire to encourage participation with the costs associated with a rigorous emissions reporting program. If measurement and reporting requirements are too rigorous and costly, there will be few participants. Conversely, if program reporting restrictions are too lenient, the resulting data may not be an appropriate foundation for a future mandatory program. Second, most voluntary registries require reporting at the company-wide level rather than the facility level. While this is appropriate for a voluntary program that tracks a corporate emissions goal, it is less useful for a sector-wide or economy-wide mandatory trading program, where it is important to carefully track emissions at the facility level. Third, the promise of "credit" for early reductions, while potentially desirable for encouraging early action and building support for an eventual mandatory program, also raises a variety of complicated issues. These types of programs raise questions about whether they are awarding credits to actions that would have happened anyway as a result of business-as-usual activities (Parry and Toman 2002). Moreover, as discussed earlier, "baseline protection" programs may imply certain methodologies for future distribution of allowances under a mandatory program.

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[17] There is also a national registry set up under section 1605(b) of the Energy Policy Act. See http://www.eia.doe.gov/oiaf/1605/frntvrgg.html.

5 The European Union Emissions Trading System

Undoubtedly, the most important development in emissions trading since the landmark SO_2 trading program has been the launch of the European Union Emissions Trading System (EU ETS) on January 1, 2005. EU officials and others have noted the influence of the SO_2 program on the EU ETS (Dimas 2005, Delbeke 2003, Zapfel and Vainio 2002, Christiansen and Wettestad 2003). Nevertheless, the EU ETS dwarfs existing U.S. trading programs in size and complexity (see Table 2), and the EU views its trading program as “shaping the future debate” over the use of emissions trading for climate policy (EC 2004a). The EU program encompasses a variety of new features and will experiment with a more decentralized approach to linking programs in the different EU Member States. It is also the flagship program in Europe’s efforts to meet requirements of the Kyoto protocol. As such, it has been both driven forward by the Kyoto mandate as well as burdened by some of the less desirable features of this international agreement. Potentially influential features of the EU ETS are discussed below.

5.1 Participation by New Sectors

The EU program incorporates a broader variety of industrial sectors than previous trading programs. For example, the program includes cement, lime, ceramics, and glass facilities, sources in the pulp and paper sector, and sources in the metal ore and iron and steel industry. Although U.S. NO_x programs have included some industrial sources, the scope and number of sources outside of the electric power sectors in the EU ETS are far greater. Inclusion of these sources has required the development of new emissions measurement protocols and may foster the development of additional options to reduce emissions. Moreover, the participation by officials from companies outside of the electric power sector, which is relatively experienced with energy trading in many companies, will shed light on how different corporate cultures adapt to the new organizational issues posed by emissions trading programs (Kruger 2005).

5.2 Flexible Monitoring, Reporting, and Verification

The European Union’s emissions monitoring, reporting, and verification system is less prescriptive than systems used in U.S. trading programs (Kruger 2005). The guidelines spell out different “tiers” of methodologies with different degrees of assumed accuracy. Firms propose installation-specific methodologies to the relevant authority in each Member State. Installations are assumed to use the top tiers, but they may petition to use lower-tiered methods with lower assumed accuracy if they show that a methodology is impractical or cannot be achieved at reasonable cost. Each member state has the autonomy to grant waivers from use of the top-tier methods (EC 2004b).

Second, in contrast to the U.S. trading systems, Member State authorities may require companies to use private, third-party verifiers. Third-party verification may reduce government costs while providing valuable technical expertise to some Member State authorities. Nevertheless, the use of third-party verification for a cap-and-trade program raises several questions, including whether third-party verifiers will provide sufficient consistency in their interpretations of the monitoring guidelines.[18]

5.2.1 Decentralized Approach

The preceding discussion of monitoring and verification illustrates how some of the features that have been decided centrally within the federal U.S. SO_2 trading program and the multi-jurisdictional U.S. NO_x programs are decentralized within the EU system. While absolute standardization is not feasible or necessary, it is an open question whether the EU ETS model strikes the right balance between consistency and national sovereignty. For example, if firms in different Member States face significantly different compliance and enforcement regimes, will there be different gaming responses that undermine both the environmental credibility and the efficiency of the trading system? This may be a particularly critical question in Member States with historically weak environmental institutions, such as new EU members from former Soviet-bloc countries or some Member States in Southern Europe.[19]

Ultimately, questions of standardization in the design and operation of emissions trading systems are applicable beyond the EU. To the extent that future climate regimes link different domestic trading systems, similar issues are likely to arise. Thus, the balance between centralized and decentralized features in the EU system should be closely evaluated during the pilot phase of the program.

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[18] A more extensive discussion of these issues appears in Kruger and Pizer 2004 and Kruger 2005.

[19] For example, Blackman and Harrington (2000) have described some of the difficulties Poland has had with enforcing its emissions fee system. Tabara (2003) argues that Spain's environmental administrative capacity has not always been adequate to face complex problems such as climate change.

5.3 Uncertainties within the EU ETS

While the EU system blazes new territory in many areas and provides important experience, it also faces a number of challenges. Many of these challenges are byproducts of uncertainties and flaws in the Kyoto agreement. For example, banking between the first and second phases of the program is not mandatory, and Member States have generally restricted banking out of concern that use of banked allowances may make it more difficult to meet the target in the first Kyoto compliance period. The lack of banking may undermine longer-term mitigation plans because firms have little incentive to implement strategies that create extra emissions reductions beyond their allocated levels. The inability to bank these “early reductions” could be a significant disincentive if prices are low in the first period and high in the second.

A more fundamental difficulty raised by the Kyoto process is uncertainty about the form and level of international commitment beyond 2012. This will constrain EU Member States in planning for the next phase of the EU ETS. It also makes it difficult for European industry to take a long-term approach to investing in climate-friendly technologies and to planning a least-cost, longer-term strategy for GHG abatement. Moreover, although banking will be available between the second period and subsequent periods, uncertainty over the structure of a future international regime could make Member States and their industries reluctant to make the investment decisions that would enable them to take advantage of a banking provision.

There is also uncertainty associated with EU ETS linkage to project-level offset provisions of the Kyoto agreement. As noted above, utilizing low-cost emission reductions in developing countries could be a critical component of cost-effective greenhouse gas trading program. In fact, analysis of EU ETS Member State National Allocation Plans shows that there will be considerable reliance on project-level offsets in many EU Member States (Zetterberg et al. 2004). Unfortunately, the provision for project-level offsets in developing countries, the Clean Development Mechanism (CDM), has been marked by problematic implementation and delays (Jepma 2005). It is not clear that the process to review and approve CDM projects will be capable of handling the necessary number of projects to meet worldwide demand for CDM credits (Kruger and Pizer 2004).

6 Conclusions

Few would have predicted the impact of the U.S. Acid Rain Program’s experiment on emissions trading. The SO_2 trading model has influenced the development of the international emissions trading regime under the Kyoto Protocol, and emissions trading has become the primary policy instrument for addressing greenhouse gases. At the same time, the SO_2 program has provided a useful benchmark as policy analysts have considered what different or additional features might be necessary for a greenhouse gas trading program. As discussed earlier, many of these features have now been incorporated into legislative and policy proposals. However, with little likelihood of quick federal action on greenhouse gas trading in the United States, the actors discussed in this paper are filling the vacuum by testing approaches and staking out positions that will likely have an important influence on future efforts on greenhouse gas trading.

What are the implications of these initiatives for a future U.S. national program? First, these programs offer opportunities to experiment with some of the mechanisms that will be needed as we advance from the relatively simple SO_2 trading model to a much more complex greenhouse gas model. For example, experiments with new offset and emissions reporting methodologies for non-CO_2 gases under state and company initiatives could provide valuable insights. Similarly, exploration of new allowance distribution methodologies under the RGGI initiative offers the opportunity to improve understanding of the distributive issues associated with allowance distribution. Finally, experience with linking domestic programs in the European Union and with linking the EU ETS to project-level offsets under the CDM could be fruitful for exploring certain aspects of the architecture of future international agreements.

The three initiatives discussed have been less trailblazing in addressing some of the other design features that are unique to greenhouse gas trading. For example, although the EU ETS covers a broader array of sectors, it still covers less than half of Europe's CO_2 emissions. In particular, it does not include emissions from the fast-growing transportation sector, and it is reportedly unlikely that new sectors will be added in the second phase of the program (Carbon Market Europe 2005). There has also been no experimentation with cost-limiting mechanisms such as the safety valve.[20]

Second, efforts to stake out potential design elements such as target types and allocation methodologies will likely grow as more companies begin to believe that a carbon constraint is inevitable. Whereas allowance allocation was a relatively new phenomenon when the Clean Air Act Amendments were passed in 1990, U.S. companies now have more understanding of the

[20]The one exception is Canada, which has proposed a safety-valve mechanism for its domestic emissions trading program. See Government of Canada 2002.

financial implications of these methodologies. The desire to influence future allowance allocations by establishing early reductions or signaling future allocation methodologies could build political support for an eventual mandatory program. On the other hand, the establishment of competing claims on allowances could also complicate the eventual development of such a program and could make it less likely that mechanisms such as auctions will be utilized.

Third, some have argued that the proliferation of state approaches to registries or trading may hasten the advent of a national program by creating a “patchwork” of state programs that cries out for federal harmonization.[21] However, with an issue as controversial as climate change policy, there is also a danger with this approach. Just as an early experiment with electricity restructuring in California may be one of the factors that has derailed momentum for national restructuring legislation (Joskow 2003), unsuccessful attempts by states on greenhouse gas trading could give ammunition to opponents of a national program. While experimentation at the state level is healthy and useful, these experiments must be successful to prove the concept for a national approach.

Given its size and visibility, the perceived success or failure of the EU ETS is even more significant. The degree to which it succeeds or fails is likely to influence deeply any future international attempt to reduce greenhouse gas emissions and the climate change that they cause. Moreover, if the EU trading program can demonstrate relatively low allowance prices and effective institutions for ensuring credible emission reductions, it will be more likely that the United States will adopt a program sooner rather than later. Conversely, if the EU program is viewed as excessively costly or ineffective, it will be a longer road from SO_2 to greenhouse gas trading in the United States.

[21] For a discussion of this political dynamic, see Swanson 2004 and Lee 2003.

Tables

Table 1: Government and Private Programs for Emission Reduction and Reporting
Chicago Climate Exchange: The Chicago climate exchange is a greenhouse gas emissions reduction and trading pilot program for emissions sources and offset projects in the United States, Canada, and Mexico. Projects also include Brazil. It is a self-regulatory, rules-based exchange designed and governed by the members. These members have made a voluntary, legally binding commitment to reduce their emissions of greenhouse gases by 4% below the average of their 1998–2001 baselines by 2006. They include around 60 businesses and around 10 other organizations.
WWF Climate Savers: The NGO World Wide Fund of Nature (WWF) has built partnerships with individual leading corporations that pledge to reduce their global warming emissions considerably worldwide to 7% below 1990 levels by the year 2010.
Environmental Defense Partnership for Climate Action: Under this program, companies partner with the NGO Environmental Defense and declare a GHG emissions target and the management actions, policies, and incentives necessary to achieve that goal. They measure, track, and publicly report net GHG emissions.
Pew Center on Global Climate Change, Business Environmental Leadership Council: Under this partnership, companies "demonstrate leadership in addressing climate change by establishing and meeting emissions reduction objectives; investing in new, more efficient products, practices, and technologies; and supporting action to achieve cost-effective emissions reductions."
Climate Leaders: Under this government-sponsored program, companies develop comprehensive greenhouse gas inventories, set corporate emission reduction targets, and report annually their emissions and progress towards reaching their targets to the U.S. Environmental Protection Agency.
Climate VISION: The U.S. Climate VISION program encourages industry efforts to reduce, capture, or sequester greenhouse gases. Climate VISION links these objectives with technology development, commercialization, and commercial utilization activities supported by the private sector and the government.

Table 2: Comparison of Key Features of the EU ETS and U.S. Programs

Features	*U.S. SO_2 Program*	*U.S. NO_x Program*	*EU ETS*
Sectors	Electric Power Voluntary opt-in of industrial combustion sources	Electric Power Large Industrial Combustion Sources	Energy (including electric power, oil refineries, coke ovens) Metal ore, iron-and-steel production Minerals (including cement, lime, glass, ceramics) Pulp and paper
Number of Regulated Sources	3,000 units[a]	2,400	12,000–13,000 installations[b]
Number of Political Jurisdictions	1 (U.S. federal govt.)	22 (21 states and the District of Columbia)	25 member states
Emissions Covered	SO_2	NO_x	CO_2, some or all of five other "Kyoto Gases" may be added later
Project-Level Offsets?	No	No	Yes (proposed)
Value of Annual Allocation	$2.25 billion[c]	$1.2 billion[d]	$37 billion[e]

[a] A "unit" is defined in U.S. trading programs as a combustion boiler. Thus, a power plant with five distinct boilers would be considered five units under the U.S. SO_2 and NO_x programs.

[b] The classification of a regulated source of emissions is different in the EU ETS than it is in the U.S. programs. An installation could consist of multiple sources of emissions that have a technical connection with the activities carried out at a site. For example, a power plant would be considered one installation, even though there are multiple boilers.

[c] Assumes an annual allocation of 8.9 million tons and an allowance price of $250/ton. (Note: SO_2 allowance prices have recently increased dramatically from this level in anticipation of the significantly tighter cap that will be required under the Clean Air Interstate Rule (CAIR) to reduce fine particulate matter. See http://www.epa.gov/cair/ for information on CAIR.

[d] Assumes an annual allocation of 500,000 tons and an allowance price of $2,400/ton.

[e] Although the size of the EU ETS cap won't be known until the National Allocation Plans for Phase II are final, Harrison and Radov (2002) cite an EU study that estimates an annual value of €30 billion ($37.5 billion) for allowances in the EU ETS.

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