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REDUCING GREENHOUSE GASES THROUGH CARBON MARKET

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INTRODUCTION

This article explores the challenges facing governments in creating a market for carbon dioxide (and other greenhouse gases, or GHGs), offers some suggestions for how that market might best be created and managed, and suggests how the creation of a carbon market helps us better understand the role of governments in making sure that markets reflect more of the true costs of the goods that are exchanged in those markets than typically occurs. It addresses four questions: (1) How are Carbon Emissions Market Externalities? (2) How Can Markets Reflect the True Costs of Carbon Emissions? (3) What Is Required for an Effective Carbon Cap-and-Trade Program? and (4) How Can Carbon Trading Help Make Markets Work More Effectively?

I argue that, in an economic system that largely relies on markets, as the U.S. and global economies do, environmental quality is greatly dependent on our ability to design and carry out public policies that ensure prices of goods reflect all of the costs, including environmental ones, that are involved in producing, using, and disposing of goods. Our failure to ensure that markets work well—that prices accurately reflect true costs—is at the heart of most environmental problems. Once markets are working as well as we can make them, there may still be the need for policies that redistribute or otherwise alter market results, and environmental justice inquiries will be a central concern, but our primary environmental law and policy challenge is to figure out how to make markets work better.

I. HOW ARE CARBON EMISSIONS MARKET EXTERNALITIES?

Climate science is extraordinarily complex, permeated by many uncertainties about the causes, consequences, distribution, and timing of climate change. One way to try to make some sense of this remarkably complex issue is to look for conclusions drawn by groups of scientists who seek to find consensus among experts. Their reports are a much more helpful guide in developing policy responses than relying on individual studies, because the synthesis reports are, in theory at least, based on studies that have undergone additional peer review and scrutiny.

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The most important such scientific consensus-building body is the United Nations' Intergovernmental Panel on Climate Change, or IPCC.[1] In 1988, the General Assembly of the United Nations asked the World Meteorological Organization and the UN Environment Programme to create a panel of scientists to study the risk of anthropogenic climate change and to provide "balanced, objective policy advice" to governments of the world to address the threat.[2] Three working groups were established to examine (1) climate science, (2) likely impacts of climate change, and (3) options for mitigating or reducing the threat.[3] The IPCC was created in response to this request. Thousands of scientists from around the world have written reports and thousands more have served as reviewers. These scientists are nominated by their governments to serve on IPCC panels.[4] All the scientists have donated their time and none has been paid for the work completed. The reports are written by a team of authors who are recognized as leading experts in the field in which they write and work from peer-reviewed scientific and technical literature. Reports are themselves subject to broad peer review and produced through a transparent process that also involves government officials from countries around the world to agree to the summary language. Each report includes a "summary for policymakers" to ensure the analysis is relevant to the policy making process. This combination of peer reviewed science and political efforts to secure broad acceptance of the major conclusions has allowed the IPCC to bridge the worlds of science and politics.[5]

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1. The IPCC was awarded the Nobel Peace Prize in October 2007, along with former Vice President Al Gore, for its work in raising awareness around the world of the threat of climate change. Press Release, Intergovernmental Panel on Climate Change, IPCC Expresses Surprise and Gratitude at Announcement of Nobel Peace Prize (Oct. 12, 2007), http://www.ipcc.ch/pdf/press-releases/pr-12october2007.pdf.

2. *Id.*

3. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, 16 YEARS OF SCIENTIFIC ASSESSMENT IN SUPPORT OF THE CLIMATE CONVENTION 2 (2004), *available at* http://www.ipcc.ch/pdf/10th-anniversary/anniversary-brochure.pdf [hereinafter IPCC, SCIENTIFIC ASSESSMENT].

4. Union of Concerned Scientists, *The IPCC: Who Are They and Why Do Their Climate Reports Matter?*, http://www.ucsusa.org/global_warming/science/the-ipcc.html (last visited Mar. 28, 2008).

5. Since uncertainty is a key theme in the climate research reviewed by IPCC working groups, their reports seek to carefully express the amount of evidence available and the degree of agreement among scientists. The level of agreement is described from low to high, as is the amount of evidence. The level of confidence seeks to reflect agreement among scientists about the correctness of a model or analysis and the language used is as follows:

Very high confidence	at least 9 out of 10 chance of being correct
High confidence	about 8 of 10 chance
Medium confidence	about 5 of 10 chance
Low confidence	about 2 of 10 chance
Very low confidence	less than 1 out of 10 chance

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, GUIDANCE NOTES FOR LEAD AUTHORS OF THE IPCC FOURTH ASSESSMENT REPORT ON ADDRESSING UNCERTAINTIES 3-4 (2005), *available at*

The first IPCC report was submitted to the UN General Assembly in 1990 and led to negotiations that culminated in the 2002 Framework Convention on Climate Change signed by attendees of the Rio Earth Summit.[6] The report argued that there was a significant likelihood that human emissions of carbon dioxide and other heat-trapping greenhouse gas emissions were warming the average temperature of the earth and that climate-based disruptions are already occurring in different regions and will become even more disruptive in the future.[7] The fourth report or assessment, like the earlier versions, was the result of a tremendous amount of scientific effort.[8] Working Group I's February 2007 report, for example, was based on the work of some 600 contributing authors in 40 countries, more than 30,000 comments from external reviewers, and editing of the summary report for policy makers by representatives from 113 governments.[9] The report concludes that scientific research leads to a "very high confidence that the global average net effect of human activities since 1750 has been one of warming" and that "[w]arming of the climate system is unequivocal."[10]

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http://www.ipcc.ch/pdf/supporting-material/uncertainty-guidance-note.pdf. Likelihood is used to reflect the probability of a particular outcome having occurred or occurring in the future. The probability range and corresponding terms used in the reports are as follows:

Virtually certain	>99% probability of occurrence
Very likely	>90% probability
Likely	>66% probability
About as likely as not	33 to 66% probability
Unlikely	<33% probability
Very unlikely	<10% probability
Exceptionally unlikely	<1% probability

These terms are used throughout IPCC reports in italics in order to make as transparent as possible the judgments made by authors about the scientific research they synthesize and assess. *Id.*

6. IPCC, SCIENTIFIC ASSESSMENT, *supra* note 3, at 1.

7. *Id.* at 3.

8. Reports issued by the UN Intergovernmental Panel on Climate Change are the most important summary assessments of climate change science. The Fourth Assessment Report, actually issued in a series of reports throughout 2007 and culminating in a synthesis report in November, includes work done by three groups: WORKING GROUP I, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, THE PHYSICAL SCIENCE BASIS (Susan Solomon et al. eds., 2007), *available at* http://www.ipcc.ch/ipccreports/ar4-wg1.htm [hereinafter WORKING GROUP I, PHYSICAL SCIENCE BASIS] (examining the interaction of human and natural factors that contribute to climate change); WORKING GROUP II, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, IMPACTS, ADAPTATION, AND VULNERABILITY (Martin Parry et al. eds., 2007), *available at* http://www.ipcc.ch/ipccreports/ar4-wg2.htm (focusing on how climate change affects natural and human systems, their vulnerability to these changes, and their capacity to adapt); and WORKING GROUP III, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, MITIGATION (Bert Metz et al. eds., 2007), *available at* http://www.ipcc.ch/ipccreports/ar4-wg3.htm (examining the scientific, technological, environmental, economic, and social aspects of mitigation, including technologies and policies that are most likely to reduce the magnitude of change); *see also* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: SYNTHESIS REPORT (Rajendra K. Pachauri et al. eds., 2007), *available at* http://www.ipcc.ch/ipccreports/ar4-syr.htm [hereinafter IPCC, SYNTHESIS REPORT].

9. WORKING GROUP I, PHYSICAL SCIENCE BASIS, *supra* note 8, at v, vii.

10. *Id.* at 3, 5.

The November 2007 synthesis report stated that "[o]bservational evidence from all continents and most oceans," the authors of the report wrote, "shows that many natural systems are being affected by regional climate changes, particularly temperature increases."[11] Most of the observed increase in globally-averaged temperatures since the mid-twentieth century is *very likely* due to the observed increase in anthropogenic GHG concentrations.[12] It is *likely* there has been significant anthropogenic warming over the past fifty years averaged over each continent (except Antarctica).[13] Emissions from humans have *very likely* contributed to sea level rise, *likely* contributed to changes in wind patterns and extra-tropical storm tracks and temperature patterns, increased temperatures of extreme hot nights, cold nights, and cold days, and *more likely than not* contributed to the increased risk of heat waves, droughts, and the frequency of heavy precipitation events.[14] Anthropogenic warming over the last three decades has *likely* had a discernible influence at the global scale on observed changes in many physical and biological systems.[15] These changes are *very unlikely* to be due to natural variability.[16]

Particularly significant is the conclusion of the 2007 report that "discernible human influences now extend to other aspects of climate, including ocean warming, continental-average temperatures, temperature extremes and wind patterns" and its emphasis on *current evidence* concerning the effects of global warming, including rising arctic temperatures, sea level rise, warming of the permafrost, more intense and longer droughts, an increase in heavy precipitation events, and an increase in intense tropical cyclone activity.[17] Many climate scientists have concluded that the nature, magnitude, and extent of the impacts of global warming are so large and threatening and the atmospheric life-time of GHGs is so long that immediate action is required to begin to reduce emissions over time, that it is prudent to reduce the risk of climate change and irrational not to take preventative steps to reduce that risk. Many scientists believe the IPCC reports issued in 2007 likely understate the threats, while a few continue to argue that the risks may be overstated. The melting of ice at the poles and the collapse of ice sheets, for example, have occurred much more rapidly than scientists predicted.[18] While there are tremendous uncertainties, the unambiguous trend in the steady increase in scientific research confirms the seriousness of the

11. IPCC, SYNTHESIS REPORT, *supra* note 8, at 2.
12. *Id.* at 5.
13. *Id.*
14. *Id.* at 6.
15. *Id.*
16. *Id.*
17. WORKING GROUP I, PHYSICAL SCIENCE BASIS, *supra* note 8, at 5-10.
18. Doug Struck, *At the Poles, Melting Occurring at Alarming Rate*, WASH. POST, Oct. 22, 2007, at A10.

threat of disruptive climate change. Uncertainties can cut both ways, and the disruptions caused by growing levels of GHGs may be much greater than anticipated. Taking actions to reduce the threat, as well as helping those who must adapt to these disruptive changes, will likely be one of the most important collective tasks of the 21st century.

The 1992 Framework Convention on Climate Change (FCCC), to which most of the countries of the world, including the United States, are signatories, commits those nations to "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[19] There is no agreement on what concentration level would ensure that the FCCC goal of preventing "dangerous anthropogenic interference with the climate system" be met,[20] but leading climate scientists argue that, given the evidence that global change is already doing damage, it is not likely that "any level equivalent to more than a doubling of the pre-industrial CO_2 concentration could plausibly be considered compliant with the convention."[21] Much of the scientific debate has centered on the conclusion that temperature increase should be kept to no more than two degrees Centigrade in order to ensure that the impacts of climate change will be relatively modest. An atmospheric CO_2 concentration of 450 parts per million (ppm) (current levels are about 425 ppm) would likely be required to satisfy the FCCC goal.[22]

In order to stabilize the CO_2 concentration at 450 ppm, these scientists have concluded that emissions will need to be cut by 60-80 percent of 1990 levels by mid-century.[23] This goal is fraught with uncertainties because of feedback mechanisms that are not well understood or difficult to predict. But if the average temperature increases by more than two degrees Centigrade, scientists fear the planet would enter into uncharted waters, where the temperature would be hotter than it has been for hundreds of thousands of years and would create an environment much different than the one in which current life has evolved. The policy challenge is to regulate markets so that prices are high enough to ensure that they include the costs of keeping emissions at safe levels.

19. United Nations Framework Convention on Climate Change art. 2, May 9, 1992, 31 I.L.M. 849 (1994).

20. *Id.*

21. John P. Holdren, *The Energy-Climate Challenge: Issues for the New U.S. Administration*, ENVIRONMENT, June 1, 2001, at 8, 13, *available at* http://www.encyclopedia.com/doc/1G1-75917475.html.

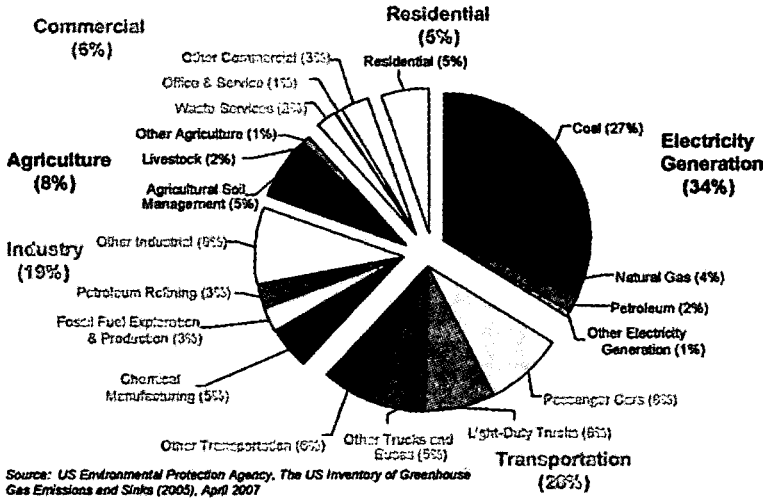
22. *Id.*

23. *Id.*

II. HOW CAN MARKETS REFLECT THE TRUE COSTS OF CARBON EMISSIONS?

Carbon emissions permeate modern economic life. Very few goods and services escape the use of electricity produced from fossil fuels or transportation powered by those fuels. The following figure, based on the Environmental Protection Agency's (EPA) inventory of greenhouse gas emissions, illustrates the broad scope of those emissions. About one-third comes from the generation of electricity; transportation sources are responsible for about 28 percent, industrial sources contribute 19 percent, and agricultural, commercial, and household sources emit the balance.[24] The EPA reports emissions in terms of teragrams of CO_2 equivalent; in 2005, total U.S. GHG emissions were 7,260 Tg CO_2, an increase of 16.3 percent since 1990 (one teragram equals 1,000,000,000,000 grams).[25] Emissions of CO_2 increased by 20.3 percent during those years, while methane and nitrous oxide emissions fell by 11.5 and 2.8 percent, respectively.[26] U.S. emissions were partly offset by carbon sequestration in biological life such as forests, urban trees, and agricultural soils that offset 11.4 percent of the total emissions.[27]

Figure 1[28]
Key Sources of Direct U.S. Greenhouse Gas Emissions by Economic Sector (2005)



24. ENVIRONMENTAL PROTECTION AGENCY, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2005, at ES-14 (2007), http://www.epa.gov/climatechange/emissions/downloads06/07CR.pdf.

25. *Id.* at ES-3.

26. *Id.* at ES-4.

27. *Id.* at ES-4-6.

28. STAFF OF H.R. COMM. ON ENERGY AND COMMERCE, 110TH CONG., CLIMATE CHANGE LEGISLATION DESIGN WHITE PAPER: SCOPE OF A CAP-AND-TRADE PROGRAM 7 (2007), *available at* http://energycommerce.house.gov/Climate_Change/White_Paper.100307.pdf.

There are a number of ways we might try to reduce carbon emissions and their role in climate change. We could enact laws and implement policies that ban certain products that release high levels of carbon, as we did in enacting amendments to the Clean Air Act in 1990 to ban products that use certain chlorofluorocarbons and threaten the stratospheric ozone layer, in response to the Montreal Protocol.[29] We can reduce the release of carbon by imposing efficiency standards on sources of carbon emissions, such as the corporate average fuel efficiency (CAFÉ) standards imposed on motor vehicle manufacturers or efficiency standards for appliances, industrial equipment, lighting, and buildings.[30] We can subsidize low carbon energy sources such as wind, solar, and hydropower, and encourage people to use less energy or cleaner forms of energy through educational campaigns. We can require electricity producers to shift to cleaner burning fuels, such as natural gas, and to sequester carbon emissions rather than releasing them into the atmosphere.

We can also act to ensure that energy prices include the costs resulting from the carbon emissions from energy production and use. This approach, as well as those listed above, are not mutually exclusive. A combination of approaches can and will need to be pursued to reduce carbon emissions. But in an economic system dominated by markets, and fundamentally organized by markets, it makes a great deal of sense to focus on correcting those markets so they reflect the true costs of producing energy. Economic theory is simple, straightforward, and compelling here, and does not even require a supply and demand chart. Markets promise to produce decisions about production and consumption that reflect the interests of consumers and promote the most economically efficient use of the available resources. If markets reflect all the costs associated with goods and services, and consumers have perfect information about the costs and benefits of alternatives, then markets will be able to produce the benefits they promise. The task of law and policy is to ensure that, as much as possible, true cost prices dominate and accurate information is available, because producers also have an incentive to maximize their profits by externalizing as many costs as possible.

Well-functioning markets can also appeal to advocates of fairness and justice in that externalities impose burdens and harms on individuals who do not benefit from transactions that fail to reflect true costs; in the case of climate change, for example, they may bear some or many of the burdens such as disruptive changes to their environment, but they receive few of the benefits that buyers and sellers enjoy. Residents of island nations that are threatened by rising sea levels largely do not benefit from

29. 42 U.S.C.A. § 7671 (West 2008); Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, 26 I.L.M. 1541.

30. The most recent energy legislation, enacted by Congress in December, 2007, included all of these measures as a way to reduce energy consumption and to reduce GHG emissions. Energy Independence and Security Act of 2007, Pub. L. No. 110-140, 121 Stat. 1492 (2007).

the jobs, salaries, air conditioning, heating, transportation, and products that also produce carbon emissions, or at least do not enjoy the benefits in proportion to the burdens they face. Reducing those externalities is a moral imperative as well as an economic one.

The two most widely discussed ways of internalizing the costs of carbon into markets are carbon taxes and carbon cap-and-trade programs. Carbon taxes can take a variety of forms, from taxes on fuels, calculated based on their carbon content, to taxes imposed on those who consume energy and other goods and services implicated in carbon emissions. Cap-and-trade programs set a ceiling or cap on total allowable emissions, allocate allowances or permits to carbon sources that set a cap on their individual emissions, and then allow the sources to meet their cap by a combination of reducing their emissions and buying excess allowances from other sources that have reduced their emissions beyond their cap and have extra allowances to sell.

Carbon taxes are an attractive policy option to help reduce GHG emissions, despite the political barriers imposed by the idea of raising taxes. If they are sufficiently high, carbon taxes can create clear incentives to reduce emissions. Unlike emission standards that, once met, provide no incentive for further innovations, taxes provide a continuous reason to find ways to reduce emissions. Taxes can raise revenue that can finance investments in energy conservation, improved efficiency, and renewable energy sources. They can help produce more efficient markets by ensuring that prices include more of the total costs of producing and using goods and services. Compared to a cap-and-trade policy, carbon taxes can be relatively simple to explain and easy to design and implement. The level of the tax can be raised and lowered as needed to ensure the necessary reductions in emissions are achieved. In sum, carbon taxes have significant benefits:

- Simpler to design and implement and easier to understand and explain;
- Can be put in place more quickly;
- Less likelihood of cheating;
- Predictability in energy prices;
- Can address more sectors of the economy;
- Creates a revenue stream that can be used to reduce other taxes or fund energy efficiency and renewables or pay for mitigation;
- Easy to adjust up or down if necessary to achieve environmental and economic goals.

Cap-and-trade approaches to reducing GHG emissions have some serious shortcomings. The compliance costs are uncertain and difficult to plan for in business and government decision making. The design of the program is complex, involving difficult choices such as at what level the cap should be set, to whom the allowances allocated under the cap should be given, whether allowances should be sold or distributed for free, and how long the allowances should last before they expire. The implementation of a program is just as daunting, requiring accurate monitoring and reporting of emissions, enforcement of allowance caps, and the imposition of sanctions for violations. Once allowances are allocated, they are difficult to retrieve if too many are distributed because their distribution can create expectations of rights of ownership that are difficult to reverse. Allocation decisions must be made within a context of uncertainty, and adjustments are difficult to make. Cap-and-trade programs have significant benefits as well:

- They do not suffer from the political opposition generated by calls to raise taxes;
- Cap-and-trade programs like acid rain have been successful in achieving their goals at lower cost than expected;
- They can be integrated with international cap-and-trade programs;
- Allowances can be auctioned to fund clean energy projects;
- If accurately set, the cap ensures environmental protection goals are achieved; carbon tax may not achieve that goal;
- The resulting market sets the price of carbon, and channels resources to projects more efficiently.

There are tremendous challenges involved in designing and implementing an effective cap-and-trade program to reduce the threat of climate change. But if those challenges can be addressed, it is an important part of the overall effort to reduce the threat of climate change. A cap-and-trade approach focuses on the key issue of what is required in order to secure a healthy environment. While it is difficult to know what exactly the cap should be, it focuses attention on the need to make policy decisions based on the best scientific evidence we have. Contrary to the argument made by tax advocates that we need policies with fixed economic costs and who reject cap-and-trade because the costs are uncertain, we need to give priority to trying to determine what is required to secure a stable climate, rather than setting an arbitrary limit on the amount of money to be spent on climate stabilization. Cap-and-trade discussions begin with the right question, even if the answer is not always clear.

As is true of a carbon tax, a cap-and-trade program seeks to ensure that markets reflect true costs. A carbon tax that reflects the true cost of

emitting carbon in producing goods and services would help achieve that purpose, but it is difficult to know what level of taxation does that. If a cap is well enough designed so that it will achieve the environmental goal, it then establishes a market mechanism for determining true costs. Prices for goods and services containing carbon, for example, if they are determined in a market shaped by such a carbon cap, will reflect at least the climate change-related costs. One major problem here, of course, is that there is not an unambiguous cap for climate change; there is no point at which we shift from no climate change to climate change, but it is a matter of degree. But we do have an emerging agreement among climate scientists, discussed above, that, at least for now, our goal ought to be an 80 percent reduction in GHG levels, from 1990 levels, by 2050, in order to keep the concentration of GHGs at no more than 450 ppm and the temperature rise at no more than two degrees Centigrade.[31] Setting the cap there, then auctioning allowances to all sources so that total emissions do not exceed the cap, allows markets to allocate scarcity in the most economically efficient manner, and avoids the very difficult political challenge of allocating emission allowances. Again, this is an imprecise calculation, fraught with difficulties and uncertainties, but it focuses attention on securing environmental quality and then using markets to achieve that goal, rather than putting an economic goal first.

Industries typically favor trading programs rather than taxes because trading programs usually distribute allowances for free. Taxes represent clearly visible cost increases, and most politicians also shy away from them. If a carbon tax could be uniformly applied to create a level playing field, it might be attractive to industries because it would make their compliance efforts much simpler than a cap-and-trade scheme. But a carbon tax would reward some industries and fuels, while penalizing others, and the creation of winners and losers make the politics of designing a carbon tax very dicey. Both cap-and-trade and carbon tax policies are difficult to design and implement in the face of powerful interests' ability to exert political pressure.

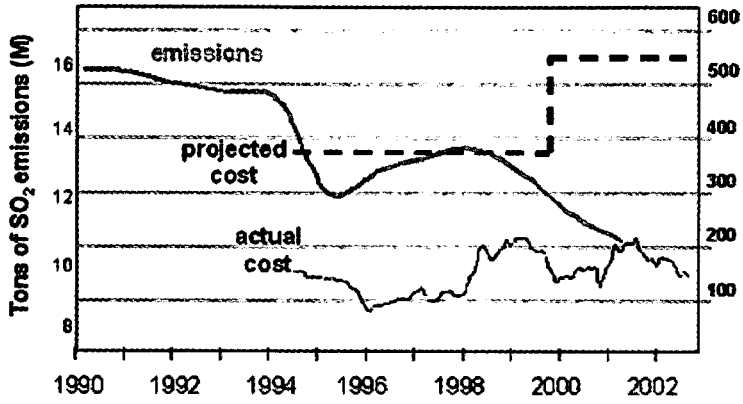
III. WHAT IS REQUIRED FOR AN EFFECTIVE CARBON CAP-AND-TRADE PROGRAM?

Carbon trading programs typically trace their origins to the federal acid rain program. The Clean Air Act of 1990 established a cap-and-trade system to reduce acid rain-producing emissions from coal-fired power plants.[32] The heart of the acid rain emissions trading system is the idea of a cap on total emissions projected, by the year 2010, to result in a reduction of sulfur dioxide emissions of ten million tons from 1980 levels.[33] The targets of the acid rain program are likely to be met, and at a

31. *See supra* note 24 and accompanying text.
32. *See* 42 U.S.C.A. §§ 7401-7671q (West 2008).
33. *Id.* § 7651.

much lower cost than expected if the cap-and-trade program had not been developed and implemented. The following figure summarizes the success of the acid rain program. Research suggests that the problem of acid deposition is far from solved, and that many lakes, streams, and forests continue to suffer from the effects of sulfur dioxide emissions. The problem requires further study but it appears that the cap may have been too low, or the goal of one cap may not adequately take into account the variety in the susceptibility of different areas to the effects of acid rain.[34] These problems highlight how critical it is to devise a cap that will ensure the environmental goal is achieved, and that is no small task for climate change.

Figure 2[35]
The U.S. Acid Rain Program



In the United States, carbon cap-and-trade proposals are being developed at the regional and national level. The Northeastern states and Eastern Canadian provinces have formed the Regional Greenhouse Gas Initiative (RGGI) that is a cap-and-trade program for power plants.[36] The Midwest GHG Accord (MW GHG Accord), involving northern Midwest states, is in its earliest stages.[37] The Western Climate Initiative (WCI), also early in its development, is developing a cap-and-trade program for Western states and provinces.[38] In Congress, the leading carbon cap-and-trade bill is the Lieberman-Warner bill, passed by the Senate

34. ELLEN BAUM, CLEAN AIR TASK FORCE, UNFINISHED BUSINESS: WHY THE ACID RAIN PROBLEM IS NOT SOLVED 1 (2001), http://www.catf.us/publications/reports/Acid_Rain_Report.pdf (explaining that acid rain is still a problem for Atlantic salmon populations in Nova Scotia, lakes in Canada and New York, streams in Virginia, fish diversity in Northern Pennsylvania, and red spruce and sugar maples in the Northeast).

35. Environmental Defense Fund, *The Cap and Trade Success Story*, http://www.edf.org/page.cfm?tagID=1085 (last visited Mar. 28, 2008).

36. *See* Regional Greenhouse Gas Initiative, http://www.rggi.org/ (last visited Mar. 28, 2008).

37. *See* MIDWESTERN GOVERNORS ASSOCIATION, MIDWESTERN GREENHOUSE GAS ACCORD (2007), *available at* http://www.midwesterngovernors.org/resolutions/GHGAccord.pdf.

38. *See* The Western Climate Initiative, http://www.westernclimateinitiative.org/ (last visited Mar. 28, 2008).

Environment & Public Works Committee in December 2007, and awaiting further action in 2008.[39] Several bills have been introduced in the House, but had not been reported out by a committee as of February 2008. The leading committee with jurisdiction over the issue is the House Energy & Commerce Committee. To move the debate forward, the Committee is issuing a series of white papers; the first paper, issued in 2007, focuses on the design of a carbon cap-and-trade program.[40]

The most developed carbon program is the European Union Emissions Trading System (EU ETS).[41] The EU is made up of 27 member states. Its powers are more limited than that of the U.S. federal government; the EU issues directives and members and member states enact laws and issue regulations that bind sources within their boundaries. Phase I of the EU ETS was a pilot phase, from 2005-07;[42] in 2008, phase II began.[43] It is a binding program designed to help the EU meet its GHG reduction target under the Kyoto Protocol, which takes effect from 2008-12.[44] The progress so far in developing or implementing these trading programs provides a number of important lessons to guide a discussion of what we should focus on in designing an effective carbon trading program.

Pre-empting States. One key question is whether there should be a national trading system or whether we should encourage regional programs. A national system is essential in developing an effort that engages the entire country, but in the absence of a federal program, regional programs provide opportunities to experiment with alternative approaches. A major problem with regional programs is that they may reduce emissions within the participating states, but emissions may increase outside of the boundaries. For example, if states agree to limit production of electricity from conventional coal-fired power plants, power from such plants might continue to be produced outside the system. If the regional program is designed to incorporate all of the states within an electricity transmission network, this problem of leakage can be minimized. More broadly, a national carbon trading program can allow states to continue to experiment, but careful coordination is re-

39. America's Climate Security Act of 2007, S.B. 2191, 110th Cong. § 4(7) (2007), *available at* http://lieberman.senate.gov/documents/acsabill.pdf.

40. STAFF OF H.R. COMMITTEE ON ENERGY AND COMMERCE, CLIMATE CHANGE LEGISLATION DESIGN WHITE PAPER: APPROPRIATE ROLES FOR THE DIFFERENT LEVELS OF GOVERNMENT (2008), *available at* http://energycommerce.house.gov/Climate_Change/white%20paper%20st-lcl%20roles%20final%202-22.pdf.

41. *See* European Union Emissions Trading System, http://www.euets.com/ (last visited Mar. 28, 2008).

42. Judit Zegnál, *EC Toughens up for Next Phase of Emission Trading*, European Union Emissions Trading System, Oct. 16-22, 2006, *available at* http://www.euets.com/index.php?page=news&newsid=42&l=1.

43. *Id.*

44. *Id.*; *see also* Kyoto Protocol to the United Nations Convention on Climate Change, Dec. 10, 1977 37 I.L.M. 22 (2007).

quired to ensure regional systems develop common approaches that can eventually be integrated.

This is part of a broader question of whether a state carbon program, to include regulatory standards such as emission limits on motor vehicles, should be preempted by federal legislation. The Senate bill protects state innovations from federal preemption, while Chairman of the House Energy & Commerce Committee John Dingell (D-MI) strongly favors preempting states in order to have one national standard.[45] Most industry groups have lobbied hard for a national standard, but state authority is critical in allowing states to continue to experiment with alternative approaches and to promote policy innovation.

Developing Accurate Inventories. Another key issue is the development of an accurate inventory in order to determine the allocation of allowances and selecting a baseline from which reductions are calculated. On May 8, 2007, more than 30 states signed on as charter members of The Climate Registry, a collaboration aimed at developing a common system for entities to report greenhouse gas emissions.[46] Canadian provinces and Native American nations have joined the effort.[47] There are a host of important issues involved in fashioning accurate GHG inventories. For example, the World Business Council for Sustainable Development and the World Resources Institute's Greenhouse Gas Protocol Initiative suggests the following principles to guide GHG accounting and reporting:

- Define boundaries that appropriately reflect the GHG emissions of the business and the decision-making needs of users.

- Account for all GHG emissions sources and activities within the chosen organizational and operational boundaries. Any specific exclusions should be stated and justified.

- Allow meaningful comparison of emissions performance over time. Any changes to the basis of reporting should be clearly stated to enable continued valid comparison.

- Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Important assumptions should be disclosed and appropriate references made to the calculation methodologies used.

45. STAFF OF H.R. COMMITTEE ON ENERGY AND COMMERCE, *supra* note 40, at 25.

46. Press Release, The Climate Registry, *Dozens of States Join the Climate Registry to Track Greenhouse Gas Emissions* (May 8, 2007), *available at* http://www.theclimateregistry.org/The_Climate_Registry_Press_Release.pdf.

47. *Id.*

- Exercise due diligence to ensure that GHG calculations have the precision needed for their intended use, and provide reasonable assurance on the integrity of reported GHG information.[48]

Another challenge is defining and verifying emissions throughout the life cycle of a product. Emissions can occur from the processing of raw materials purchased for manufacturing, as a result of the production of the electricity used in manufacturing components, and from the transportation, use, and disposal of products, and from other activities. These complex calculations must be broad and inclusive to ensure emissions are not excluded.[49] Reporting and monitoring mechanisms need to be efficiently integrated with requirements under environmental laws in order to minimize the costs of participating in the program.

Determining the benchmark is also difficult. The generation of GHG reduction credits is based on the calculation of the level of GHGs that would have been emitted in the absence of a project. This is a hypothetical figure that is difficult to calculate. There is a strong incentive for sources and nations to inflate their GHG inventory in order to be in a position to claim more reduction credits. Governments may be hard

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48. WORLD RESOURCES INSTITUTE, THE GREENHOUSE GAS PROTOCOL: A CORPORATE ACCOUNTING AND REPORTING STANDARD 7 (2001), http://www.wbcsd.org/web/publications/ghg-protocol.pdf. A related issue centers on defining the boundaries of a firm's emissions. The World Resources Institute report suggests that companies use organizational boundaries for determining GHG emissions responsibility that are consistent with boundaries established for financial reporting. *Id.* at 14-15. They recommend that emission inventories include emissions over which companies have "significant control" and represent direct emissions as well as indirect ones resulting from the electricity they purchase. *Id.* at 43. Control is defined as "the ability of a company to direct the operating policies of another entity/facility. Usually, if the company owns more than 50 percent of the voting interests, this implies control." *Id.* at 15. Significant influence is a function of the following factors: (1) "the company owns voting interests of between 20 and 50 percent"; (2) "the company has the power to participate in the entity's/facility's financial and operating policy decisions"; and (3) "the company has a long-term interest in the entity/facility." *Id.* The reports recommend the following emissions be reported, as determined by the specific business and industry context and based on accepted financial and accounting standards:

- All GHG emissions from those entities/facilities which are defined as being controlled—wholly owned and not wholly owned but controlled;
- The equity share emissions from jointly controlled assets/entities; and
- The equity share of emissions from entities/facilities over which the reporting company has significant influence but does not control.

Id. at 15-16.

Direct emissions include production of electricity, heat, and steam; physical or chemical processing; transportation of materials, products, waste, and employees; and fugitive emissions. *Id.* at 21. Indirect emissions include emissions associated with the generation of imported or purchased electricity, heat, and steam, and should be reported separately. *Id.* Other indirect emissions that could be reported include employee business travel; transportation of products, materials, and waste; outsourced activities, contract manufacturing, and franchises; emissions from waste generated by the reporting company that actually occur at other sites not owned by the company, such as methane from landfills; emissions from the use and end-of-life phases of products and services produced by the reporting company; employees commuting to and from work; and production of imported materials. *Id.*

49. *See* CHRISTOPHER P. LORETTI ET AL., PEW CENTER ON GLOBAL CLIMATE CHANGE, AN OVERVIEW OF GREENHOUSE GAS EMISSION VERIFICATION ISSUES 39 (2001), http://www.pewclimate.org/docUploads/emissions_verification.pdf.

pressed to be able to calculate accurate baselines. There will be strong incentives to establish generous baselines and credits. The calculation of credits requires certifying bodies to be able to ensure that reductions are permanent and additional. Should projects aimed at reducing local air pollution be eligible for funding as a source of GHG credits? Should projects planned for other reasons be part of the baseline? Should governments be able to claim credits for reducing subsidies, reforming prices, deregulating economic sectors, and restructuring energy production?

Setting a Cap. Setting the cap on total emissions is a critical decision. Deciding what GHGs to include is critical here. Most trading programs just include CO_2; the Senate bill includes all six GHGs.[50] One option is to aim for the goal of an 80 percent reduction by 2050, with intermediate goals or benchmarks to ensure progress. A number of states have already set caps, and the size of the caps and deadlines vary greatly, as shown in the following table:

Table 1[51]
GHG Caps and Dates

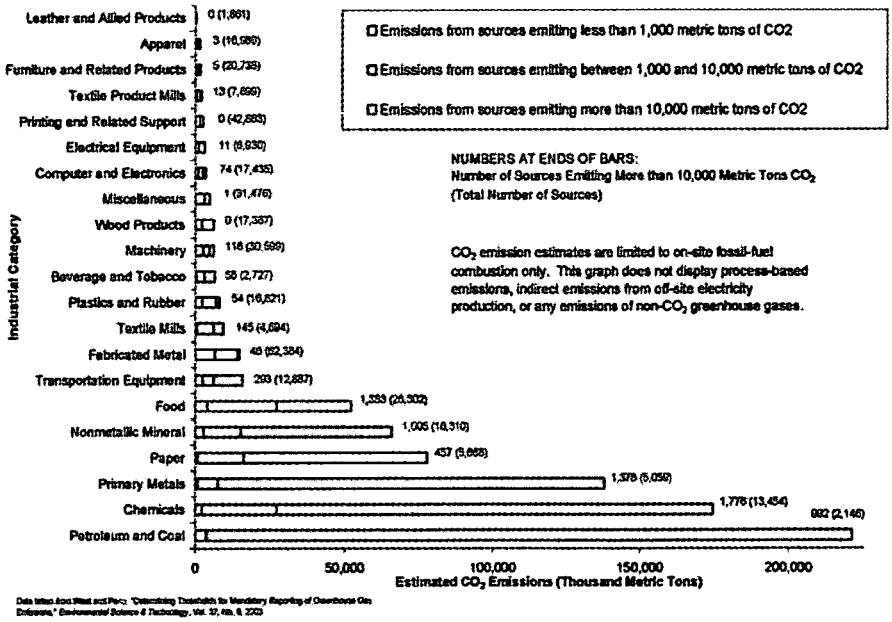
Year	Cap
2100	75% cut: RI
2050	75-80% cut: CA, CO, CT, FL, MA, ME, MN, NJ, NM, OR NH & VT, no date 50-60% cut: AZ (by 2040), IL, WA
2035	25% below 1990 levels: WA
2025	back to 1990 levels: FL; back to 2000 levels: VA; 30% cut: MN
2020	back to 2000 levels: AZ; back to 1990 levels: CA, HI, IL, NJ, WA 10% cut below 1990 levels: MA, ME, NM, NY, OR, RI, VT; 20% cut below 2005: CO
2017	back to 2000 levels: FL
2015	15% cut: MN
2012	back to 2000 levels: NM
2010	back to 2000 levels: CA; back to 1990 levels: CT, MA, ME, NH, RI, VT

50. America's Climate Security Act of 2007, S.B. 2191, 110th Cong. § 4(15) (2007), *available at* http://lieberman.senate.gov/documents/acsabill.pdf.

51. PEW CENTER ON GLOBAL CLIMATE CHANGE, CLIMATE CHANGE 101, STATE ACTION 3, 7, *available at* http://www.pewclimate.org/docUploads/101_States.pdf (last visited Mar. 28, 2008).

Determining Who Is Required to Hold Allowances. RGGI only applies to fossil-fuel fired electric generating units ≥ 25 megawatts (Mw) of power.[52] The EU ETS regulates downstream installations—those that actually release emissions. This includes 11,500 large stationary sources and installations; motor vehicles are not included; airplanes may be added later.[53] The Senate bill covers 87 percent of total emissions; the House bill focuses on large sources.[54] While there are hundreds of thousands of GHG emitters, most of the emissions come from major sources, so the regulatory task is not quite as daunting as it might appear, as demonstrated by the following figure.

Figure 3[55]
Large Emitters of CO_2 from Fossil Fuel Combustion in Each Manufacturing Industry



Allocating Initial Allowances. A major issue is whether allowances should be auctioned or distributed for free. Auctioning allowances has

52. REGIONAL GREENHOUSE GAS INITIATIVE MODEL RULE at 21 (2007), *available at* http://www.rggi.org/docs/model_rule_corrected_1_5_07.pdf.

53. Peter Zapfel, European Commission, *Webinar Regarding the EU Emission Trading Scheme*, *available at* www.climatechange.utah.gov/docs/Webinar_5.ppt (last visited Mar. 28, 2008).

54. America's Climate Security Act of 2007, S.B. 2191, 110th Cong. §§ 3101, 3201 (2007), *available at* http://lieberman.senate.gov/documents/acsabill.pdf.

55. STAFF OF H.R. COMMITTEE ON ENERGY AND COMMERCE, *supra* note 40, at 17.

many advantages. Allowances are allocated through a market mechanism, promoting their efficient allocation. Sources that have reduced emissions voluntarily are not punished, because they now need to purchase fewer allowances, while those that have put off reductions have to buy more. The revenues from the auctions can be used to subsidize emissions-reducing activities, fund research and development, help meet adaptation costs, and for other relevant purposes. Auctions can raise prices of high-emitting processes and facilities and encourage reductions. But auctions are strongly opposed by industries that naturally prefer their free distribution, and many carbon trading programs anticipate an initial free distribution, with auctions to come later. RGGI is proposing at least 25 percent of the allowances be allocated for consumer benefit and/or strategic energy purpose (end use energy efficiency) and 75 percent be left up to states.[56] Under the EU ETS, national allocation plans distribute allowances; up to five percent were auctioned in phase I; up to 10 percent in phase II.[57] The Senate bill gives less than 50 percent of allowances to states for load serving electricity generating entities and farmers and foresters for sequestering; the balance goes to regulated sources; 15 years into the program, over 70 percent are to be auctioned; the balance are to be given to states and entities above, and not to specific facilities.[58]

Determining Whether to Allow Offsets. Offsets are allowances or credits that regulated entities can purchase by investing in projects that emit fewer GHGs, such as electricity-generating windmills, or that sequester carbon, such as tree plantations. Sources may find it cheaper to pay for these offset programs than to reduce their emissions. From the perspective of economic efficiency, for example, trading should be as broad as possible and be open to as many parties as possible. But trading also poses the problem of appearing to allow sources to buy credits from others rather than reducing their emissions. There are also concerns that trading will allow sources to invest in carbon sequestration projects with uncertain or only temporary benefits rather than actually reducing their emissions.

Projects aimed at reducing GHG emissions or increasing carbon sinks may create incentives for increased emissions/decreased sinks elsewhere. For example, if some sources shift away from using coal, that might deflate coal prices and stimulate increased use by others. Carbon sequestration may be pursued through investments in plantations that displace farmers and encourage them to move to other areas and cut down trees for croplands. One of the cheapest ways of generating GHG credits is to invest in the protection or expansion of carbon sinks, such as

56. RGGI, OVERVIEW OF RGGI 4, http://www.rggi.org/docs/mou_rggi_overview_12_20_05.pdf (last visited Mar. 28, 2008).

57. EU ETS, Auction 2006, The Auction's Legislative Background, http://www.euets.com/index.php?page=75&l=1 (last visited Mar. 28, 2008).

58. §§ 3101, 3201.

planting trees and no-till cultivation. But this raises numerous problems, such as how to determine what the baseline is of carbon sequestration before a project is pursued, so that credits can be accurately calculated.

Under RGGI, offsets are limited to specific kinds of projects, independent verification is required, and they can come from other RGGI states or other states that have signed memoranda of understanding with RGGI officials.[59] Each source may cover up to 3.3 percent of its total obligation with offsets; if prices reach $7/ton, offsets can satisfy five percent of total obligations; if they reach $10/ton, offsets can be used for up to 10 percent of the obligation.[60] Offsets under the EU ETS are governed by the Kyoto Protocol, which requires that offsets are permanent, verifiable, and additional (beyond business as usual and clearly demonstrated to be an additional step taken expressly to reduce GHGs).[61] No offsets are allowed for nuclear power or carbon sinks; limited offsets are available for hydropower, and all offsets must be less than 13.5 percent of the national cap.[62] The Senate bill allows sources to meet up to 15 percent of their cap from offsets; an additional 15 percent can be credits from foreign markets if EPA-certified; and another 15 percent can be borrowed from future year caps; the term of loan is 5 years with 10 percent interest.[63]

The experience under the Clean Development Mechanism (CDM) illustrates how emissions trading programs can fail. According to Victor and Cullenward, about one-third of all CDM pipeline credits have been generated by controlling trifluoromethane or HFC-23, a byproduct from manufacturing.[64] In the industrialized nations, plants have installed devices to remove the emissions. However, in the developing countries, manufacturers have not installed the equipment in order to keep their emissions high and to position themselves to sell credits to EU sources looking for ways to offset their emissions. These companies are expected to make profits of more than $12 billion through 2012.[65] If the wealthy countries would have simply paid for these companies to install HFC-23 controls, the total cost would only have been $136 million.[66] Simply because a market mechanism is in place, there is no guarantee that it will operate efficiently.[67]

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59. REGIONAL GREENHOUSE GAS INITIATIVE MODEL RULE, *supra* note 52, at 63.
60. *Id.*
61. Kyoto Protocol, *supra* note 44, at Art. 3.
62. Zapfel, *supra* note 53.
63. America's Climate Security Act of 2007, S.B. 2191, 110th Cong. §§ 2301-2303 (2007), *available at* http://lieberman.senate.gov/documents/acsabill.pdf.
64. David G. Victor & Danny Cullenward, *Making Carbon Markets Work*, SCI. AM., Sept. 24, 2007, at 70, *available at* http://www.sciam.com/article.cfm?id=making-carbon-markets-wor.
65. *Id.*
66. *Id.*
67. *Id.*

Deciding Whether to Include a Safety Valve. A safety valve is a mechanism that ensures prices of allowances that sources buy to meet their obligations do not exceed a certain price. It has been a key issue in congressional debates as industry groups lobby for limits on the cost of the program. While it brings some certainty to compliance costs, safety valves threaten to violate the idea of an environmentally-determined emissions cap. They may represent a political compromise between the environmental protection goal and keeping a lid on compliance costs, but that comes at the price of reducing the efficiency of the market. RGGI deals with the issue by allowing offsets, as described above.[68] If prices are $\geq$ $10/ton, sources can buy international offsets that are regulated under the Kyoto Protocol. The EU ETS does not include a safety valve.

Ensuring Accurate Monitoring, Compliance, and Enforcement. Effective enforcement that creates incentives for compliance is critical to the success of carbon trading. But there are conflicting imperatives to be balanced. Simple rules, minimal transaction costs, and other factors lead to maximizing the volume of trading and the consequential benefits, while effective compliance and enforcement places limits and costs on the process. Sanctions for noncompliance must be developed. Who should bear responsibility for non-fulfillment of conditions—the buyer? the seller? government? It may be possible to devise insurance schemes, funded by charges imposed on each transaction that can be used to purchase credits to meet shortfalls. The system could include extra credits to be used for such a purpose. Sanctions for failure to comply with conditions could include a prohibition on future trading and reduction of subsequent allowances by the number of credits in dispute. Generators of credits may be required to demonstrate that real reductions have been produced before trading can occur, as is the case in other commodity markets, where producers must show that the product is available and certify its quality. This requires strong political will to sanction parties that fail to meet their obligations.

Enforcement provisions in existing trading programs vary considerably. The RGGI, for example, is based on a three-year compliance period. Allowances can be banked for future use, but borrowing from future years' allowances is prohibited.[69] Under the EU ETS, sources must monitor and report annual emissions by March 31 for the previous year.[70] Emissions are based on calculations for different kinds of fuel.[71]

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68. *See supra* notes 59-60 and accompanying text.

69. Regional Greenhouse Gas Initiative, Public Review Model Review Draft, 3/23/06, sec. XX-6.6, *available at* http://www.rggi.org/docs/public_review_draft_mr.pdf.

70. Council Directive 2003/87/EC 2003 O.J. (L275 25.10.2003) of the European Parliament and of the Council, Oct. 13, 2003, establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (as amended by Council Directive 2004/1/EC 2004 O.J. (L338 18 13.11.2004)) art. 15.

71. *Id.* annex IV.

Self reporting is subject to third party verification.[72] Sources must surrender allowances by April 30 for the previous year.[73] The failure to surrender allowances results in a fine of 100 euros/allowance and the source must eventually surrender the allowance.[74] The name of non-compliant companies is published (the "name and shame" penalty).[75]

One of the biggest challenges to carbon trading is bringing developing countries into the regime. Given the volume of emissions from China, India, and others, this is absolutely essential. And including the developing countries in a regulatory program is a prerequisite for support from members of Congress and others for U.S. involvement in a global program. But these countries largely lack the kind of effective governmental regulatory infrastructure and capacity that is required for an effective program. It is hard to envision a global carbon trading program working until this key challenge is addressed. Otherwise, we run the risk of leakage—i.e., that emissions might be reduced in one area but simply increase in another.

IV. MAKING MARKETS WORK

Market forces largely drive the decisions about what goods and services are produced, how they are produced and used, and what their environmental consequences are. Making markets work better, by ensuring that prices include more of the true costs of producing and consuming goods and services, is essential in producing a more ecologically sustainable economic system. Because greenhouse gas emissions permeate the economy, climate policies must be able to reach and reshape virtually all sectors of the economy. A broadly based cap-and-trade program or a carbon tax can provide the basic structure for ensuring markets do a better job of taking into account the costs of carbon emissions. Generating support for such an expensive political intervention into markets, one that will raise prices significantly and will produce significant opposition, requires a clear understanding of the intersection of public policies and markets.

Markets are inescapably located in and constrained by the natural world. Natural resources are exhaustible and natural systems are, overall, irreplaceable. Capitalism is entirely dependent on the resources of the natural world and its ability to process wastes, and only economic activity that is consistent with ecological conditions and limits is ultimately sustainable. For some, their faith in markets gives no room for doubt about the viability of a world characterized by profound and growing inequality made acceptable by the promise of endless economic

72. *Id.* art. 16.
73. *Id.* art. 15.
74. *Id.* art. 16.
75. *Id.*

growth. Effective governance is required to rescue capitalism from unsustainable environmental and economic trends, but part of the problem with capitalist ideology is its commitment to weakening government, the very thing on which its future depends.

Discussions of politics and markets often focuses on the differences between political and market allocation of scarce resources. Politics is denigrated as irrational, plagued by political calculations, pressures, and incentives that are aimed at currying favor with powerful industries, insulating and protecting industries rather than forcing them to compete, and dominated by subsidies and pork barrel spending that are economically inefficient. Markets, in contrast, are paragons of virtue, designed to provoke innovation, reduce costs, and expand choices.

Characterizing politics and markets as polar opposites is an attractive strategy for those who wish to reduce political decision making and unleash private power, but it fundamentally misstates the nature of markets. Many markets fail to produce the benefits promised because they do not work well; their prices do not reflect the true costs of goods and services, because powerful interests that can externalize costs on third parties have a strong incentive to do so. Excluding some costs increases profits and expands market share, while imposing costs on other interests that are powerless to protect against them, or are so widely disseminated that there is little incentive to protest.

A more helpful approach looks at the intersection of politics and markets and their inviolability. Effective markets require strong and capable institutions to ensure that the benefits promised by markets are realized, and are not amid the relentless push to maximize profits. Markets require strong and effective governmental institutions to assign property rights, monitor emissions, and enforce requirements. Policy design and implementation are essential in ensuring that carbon markets produce the benefits they promise. If effective markets can be constructed and maintained, they can play a major role in reducing the threat of climate change. Well-functioning markets are clearly only part of the prescription. Regulations, subsidies, research, education, and other policies are also needed. And even if well functioning markets are established, additional policies will be required to deal with the distributional consequences of markets. Policies will need to address the impacts of climate change and help those who suffer its disruptions adapt. Well-functioning markets are part, but only part, of the broad set of actions humankind will likely need to pursue throughout the century as it finds ways to secure a healthy planet for all forms of life.

CONCLUSION

Carbon trading is only part of an efficient and effective response to reducing the threat of climate change. Investments in energy and materials efficiency, conservation, pollution prevention, renewable energy, and

more efficient resource use make sense for economic and environmental reasons apart from climate change. Because GHGs, once released, may stay in the atmosphere for a hundred years or longer, immediate, precautionary action is prudent as well as a long term risk reduction strategy. The longer we wait to reduce the threat of climate change, the larger the problem grows and the narrower our options become; the sooner we act, the more options we will have in the future. Carbon trading programs can produce valuable experience about how market-based systems can work to find the most cost-effective ways to reduce GHG emissions and help secure a stable climate.