International Emissions Trading Association (IETA)

Economics of Greenhouse Gas Trading: Reaching Environmental Goals Cost Effectively

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Overview

The American Clean Energy and Security Act of 2009 (ACES) marked the first time in United States history that comprehensive climate legislation, regulating the emissions of greenhouse gases, was passed by the House of Representatives. The bill's two main sponsors were Representatives Henry Waxman (D-CA) and Ed Markey (D-MA). ACES' 1428 pages combine several major energy-policy initiatives into one bill, including: federally mandated renewable portfolio standards, energy efficiency targets, various research and development programs and a cap on the emissions of harmful greenhouse gases. This final provision, known as a cap and trade program sets a hard limit on greenhouse gas emissions, while creating a regulated emissions trading system for companies and market participants to buy and sell emissions allowances. The Senate recently released a Chairman's Mark of draft legislation introduced by Senators Kerry (D-MA) and Boxer (D-CA) which is also a cap and trade program.

Cap and trade is not a new concept and its merits have been well proven over the past two decades, beginning with the national SO2 emissions trading that was set up by the Clean Air Act Amendments of 1990 (CAAA). Despite this public policy success story, some policy makers and observers have raised concerns regarding the role of emission trading in reducing greenhouse gas (GHG) emissions. Many of these concerns have focused on the potential complications associated with the creation of such large-scale carbon markets. [1] Media coverage has focused on criticisms regarding the potential threat of market manipulation and price volatility associated with the trading component of the proposed federal cap and trade programs. *The Richmond Times-Dispatch* reported that "…cap and trade is too volatile, complex and susceptible to manipulation to sustain the needed investment milieu."[2] Several U.S. Senators have also made statements regarding the role of carbon markets in general and the level of participation financial institutions should have. In August, Bloomberg.com reported that Senator Byron Dorgan (D-ND) said he will "oppose creating any carbon market".[3] Fears of market manipulation and extreme speculation have also been voiced by ranking members of the Senate. Recently, former Agriculture Committee Chairman Tom Harkin (D-IA) said "If we're serious about cap and trade system, that means we must get the trading part right." He also added "I'm concerned about the potential for excessive speculation in carbon credits to distort their value."[4]

This anti-emissions trading rhetoric is unfounded. In fact, the evidence and experience to date demonstrates that emissions trading markets function well and are very cost effective. They reduce emissions at lower costs than the "command and control" approach (e.g. inflexible facility by facility emissions standards), while ensuring that the environmental objectives are met, as is documented by a substantial body of academic analysis. [5] In fact, many authors argue that the cap and trade approach achieves a stronger environmental outcome than command and control approaches. Further, there has been no significant experience of market irregularities or manipulation[6] in emission markets.

1 New Carbon Finance economic research predicts a potential $1 trillion U.S. carbon market by 2020.

2 The Richmond Times-Dispatch: "Backlash from House Bill is driving Senate Delays", August 30, 2009.

3 Bloomber.com: "Goldman, JPMorgan Face Carbon Market Curbs in Senate Proposals", August 13, 2009.

4 Agriculture Online: "Carbon trading needs to be transparent, lawmakers told", September 10, 2009.

5 Ellerman (2007)

6 The oft-cited collapse of Phase 1 EU ETS Allowance prices is something of a red herring. While the collapse did occur its causes were entirely regulatory in nature and derived from setting the initial cap above actual emissions, resulting in structural oversupply. The precipitous collapse itself was driven by the release of yearly emissions data that revealed the structural oversupply. This structural issue has been remedied and Phase 2 of the EU ETS is not subject to this problem due to 1) a tighter cap that ensures structural demand throughout the compliance period; ,and, 2) provisions allowing banking of surplus allowances to be banked into Phase 3, when the emissions budgets ratchet down significantly.

How Emissions Trading Systems Work

In its simplest form, a "cap and trade" program has two main components. The first component is a ceiling or "cap" established on aggregate air emissions, which typically declines over time. This declining or "phasing-in" of the cap sets a maximum limit on emissions and imposes a legal obligation that ensures the specific longer-term environmental goals are met. By phasing in the cap over multiple periods, companies regulated by the program can begin investing in compliance while reduction requirements are less aggressive, and then accelerate their strategies as the cap is ratcheted down over time. Emitters within economic sectors covered by the program are responsible for reducing their emissions to comply with typically annual emission targets. Without the legal certainty of future emission levels afforded by the hard "cap" the environmental objectives of the program may not be achieved. In contrast, programs that use emissions fees or taxes (e.g. a carbon tax) impose no legal obligation on the number of tons that can be emitted and thus provide no assurance that specific emissions targets would be achieved.

The second component in a cap and trade program is a market-based emissions trading system. An emissions trading system, which has become synonymous with the "trade" component in a cap and trade program, is created and regulated by government and provides for the use of emissions permits or "allowances" as a form of compliance with the stated emissions caps. Each allowance is the equivalent of one ton of emissions. Companies whose emissions are greater than their allocation or share of the cap are able to purchase allowances to meet their reduction goals. Companies that reduce their emissions more than required by their allocation are able to sell the excess allowances in the open market or to other companies interested in purchasing them. The tradable permit market that ensues from this structure provides clear price signals regarding the value of emissions reductions and allows rational economic decision making and risk management techniques to govern capped sources' emissions management and control decisions.

Several other notable cost containment mechanisms help to create an even more cost-effective emissions trading system. First is the concept of "banking" emissions allowances. Banking allows companies that are regulated by the program to carry forward unused allowances from previous compliance years and use them to meet future years' compliance goals. Banking has proven to be an important mechanism in reducing compliance costs because it provides companies with the flexibility of making additional emissions reductions earlier than required in order to avoid some future required reductions when the costs of compliance are much higher.

"Borrowing", another cost containment mechanism, allows companies to borrow allowances from future compliance periods and submit them for current-year compliance periods. Borrowing was first introduced in the European Union's Emission Trading System as a means to both reduce compliance costs and dampen allowance price volatility. The creation of a "strategic reserve" of allowances is another cost-containment mechanism by which allowance price volatility and compliance costs can be mitigated. The concept of a strategic reserve has been incorporated into several recent U.S. climate bills, including ACES and the recently introduced Senate bill, but has yet to be implemented in an operational cap and trade program. In ACES, a strategic reserve would be established by setting-aside a fixed amount of allowances from each compliance period and auctioning those allowances off to market participants at a predetermined minimum price. The reserve would help stabilize market prices by injecting additional allowances into the market when market prices reached the reserve's minimum auction price.

Another important mechanism of an emissions trading system, particularly with regard to greenhouse gases emissions, is the concept of an "offset". Offsets represent actual, verified emission reductions made by greenhouse gas emitting sectors that cannot practicably be included under the cap. Examples include the U.S. agricultural and forestry sectors and certain sectors within developing countries. By utilizing market incentives, qualifying projects are able to reduce their overall emissions at a relatively low cost. Offsets are important because companies regulated by an emissions cap are able to purchase offset credits and use them towards their own compliance goals, generally at a cost lower than either purchasing allowances or pursuing more costly internal abatement options. Most economists and analysts expect that offsets will be a low-cost way for companies to meet their compliance goals by allowing them to access equivalent lower cost reductions outside of the cap, while achieving the same aggregate reduction of emissions. Offsets are a viable part of greenhouse gas emission programs since the effects of GHG emissions are the same wherever they are emitted in the world, unlike the case for the local or regional pollutants such as SO_2 and NO_x. Offsets also provide a valuable temporal bridge, allowing early emissions reductions objectives to be met at reasonable cost while new clean energy technologies are developed and available for commercial-scale deployment. This temporal "breathing room" is particularly important for the deployment of long-lived energy infrastructure where premature retirement of existing assets and replacement with marginally improved technologies has the potential to lock-in sub-optimal emissions performance, increasing long-run societal cost.

International offsets are also particularly important because of their relatively low cost and, critically, their role in providing incentives for the sustainability of tropical rain forests and the promotion of low-emitting technology in developing countries. The U.S. Environmental Protection Agency (EPA) analysis of ACES found that emissions allowance prices would increase by 89% if no international offset use were allowed[7].

History of Emissions Trading Systems

Forty years ago, Canadian economist John Dales demonstrated that an emissions-trading system, in which rights to emit pollution or emission allowances are available in fixed and limited aggregate amount and are freely tradable, would induce rational firms to reduce pollution at the least possible cost. Dales' 1968 landmark work "Pollution, Property and Prices", continues to remain a widely influential and oft-cited book by both environmental policy makers and academics alike. Over this same time period, the alternative "command-and-control" approach to environmental policy has been applied to a wide variety of problems with far less success. Excessive costs and/or failure to successfully achieve environmental objectives have often been the result.[8]

Over the last four decades, since Dales' theory, there has not only been general acceptance of the theory of emissions markets but also growth in their application, both in the U.S. and internationally. The emissions trading system outlined in ACES, if ultimately passed into law, would be the first example of market-based instruments being utilized to reduce greenhouse gas emissions in the U.S. on a national, economy-wide basis. However, this would not be the first time environmental goals have been met through market-based systems. That distinction goes to Title IV of the 1990 Clean Air Act Amendments (CAAA), also known as the U.S. Acid Rain Program.

The Acid Rain Program marked the first large-scale environmental regulatory effort which utilized emissions markets and tradable allowances for compliance purposes. The program mandated a 50% reduction from the 1980-level of electric utility emissions of SO_2, the major precursor of acid rain. Phase I of the Acid Rain Program began in 1995. The mechanics of the Acid Rain Program are straight forward. Each electric generating unit "covered" by the SO_2 cap is allocated allowances equal to their permitted SO_2 emissions, as defined by the cap. At the end of each year, reported emissions had to be less than or equal to the allocated allowances. In the event that a covered unit emitted more SO_2 than covered by its allocated allowances, allowances transferred from other units, purchased from other utilities or on the open market could be used for compliance. Units that emitted less SO_2 than allowed could sell their excess allowances or bank them for future compliance years. The development of an SO_2 trading market was the first major departure from traditional command and control regulatory approaches to environmental objectives. A central tenet of that development has been open market access for regulated entities and liquidity providers such as financial institutions and a healthy mix of use between exchange trading and over-the-counter trading. The U.S. Acid Rain Program's early successes led the way for the second major U.S. emissions trading system, the NO_x budget trading program.

The Ozone Transport Commission (OTC) NO_x Budget Trading Program (OTC NO_x) also originated from the 1990 Clean Air Act Amendments. Twelve Northeast states and the District of Columbia coordinated common actions and set up a

7 EPA Analysis of the American Clean Energy and Security Act of 2009 (PDF) , Slide 13

8 Ellerman, Joskow, Schmalensee, Montero and Bailey (1997)

regional cap and trade program to reduce regional tropospheric ozone or “smog”. The OTC NO_x program was the first multi-jurisdictional trading program operated at the state level. The first phase of compliance was from 1999 – 2002 with the goal of reducing the incidence of ozone non-attainment by regulating the emissions of NO_x from generating units. The trading period was unique in that it only operated in the summer months (May – September), when ozone concentrations are of the greatest concern.[9] Similarly to the Acid Rain Program, banking of allowances was permitted. However, the OTC NO_x program established a provision called “progressive flow control” to restrict the amount of allowances able to be withdrawn from a source’s allowance bank. The OTC NO_x program was eventually merged into the federally managed NO_x State Implementation Plan (SIP) Call program (NOx SIP Call) in 2003.

The NO_x SIP Call program, promulgated by the EPA in 1998, targets 20 states (including the 12 states covered under the OTC NO_x program) and the District of Columbia to regulate NOx emissions from generating units. This program began in 2004 (2003 for states covered under the OTC NO_x program) and sought to achieve a 22% reduction in national NO_x emissions by 2007. The same flexible trading mechanisms authorized in the NOx Budget program were available for sources in the SIP Call program, including allowances providing the right to emit one ton of NO_x and the progressive flow control of banked allowances. The NO_x trading market developed quickly. Most observers attribute this to the participation of both compliance and financial players and the expansion of a largely over-the-counter derivatives market that was already developing in the SO_2 market. The Acid Rain Program, the OTC NO_x and SIP Call trading programs are clear examples of emissions trading systems that were successfully utilized to achieve environmental objectives.

In 2005 the EPA issued the Clean Air Interstate Rule (CAIR). CAIR was largely a combination, continuation and expansion of both the Acid Rain Program and the NO_x trading programs, with substantial additional reductions in annual SO_2 and NO_x emissions. The expansion of the prior programs was grounded in the evidence and experience that market-based environmental systems worked in achieving low-cost emissions reductions. While the federal D.C. Circuit court recently invalidated CAIR, and ordered EPA to revise it consistent with its opinion, the SO_2 and NO_x programs established therein remain in force until EPA promulgates new rules, which should take approximately two years.

At the same time the U.S. was utilizing cap and trade programs to reduce SO_2 and NO_x emissions, the international community began to consider emissions trading programs as a means to address global warming. Largely as a response to the 1997 Kyoto Protocol, in which the first international treaty regulating the emissions of greenhouse gases from Annex I countries was signed, the European Union (EU) developed an emissions trading system to cover the original 15 member-states in the EU. Within a short period of time, the EU had agreed upon a directive formalizing a three-year trial period beginning in 2005 (Phase 1) to be followed by a five-year compliance period ending in 2012 (Phase 2) coinciding with the First Commitment Period under the Kyoto Protocol. The EU emissions trading system (EU ETS) soon was expanded to cover 30 European countries covering electricity generation and most heavy industry. Emissions caps were set according to multi-year compliance periods and allowances apportioned to participating countries. Each participating country then allocated the allowances to companies within sectors covered under the cap. Once the initial, trial period was concluded, flexible mechanisms such as banking and offsets were authorized in Phase II of the EU program. A monitoring, reporting and verification system was also established to ensure the integrity of the system and of the allowances traded among countries. This emissions trading system marked the first multi-national greenhouse gas regulatory program and the first time emissions markets were being utilized to address the climate, health and humanitarian problem of global warming. [10]

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9 Ellerman, Joskow, Harrison (2003)

10 Further validating the efficacy of emissions trading, the Chinese government implemented in 2008 a small S02 trading program for reducing sulfur pollution from large stationary sources which are contributing to a significant acid rain problem. Whether the S02 emission trading program is expanded nationally is an open question but discussions between Chinese policymakers and U.S. environmental NGO advisors clearly indicate the government’s appreciation of the U.S. acid rain program’s success.

Cost Savings and Environmental Benefits of Cap and Trade

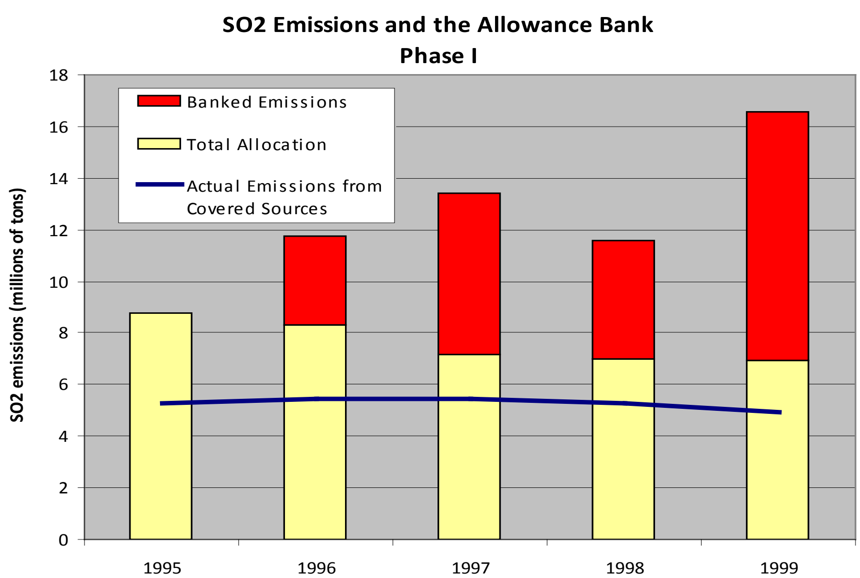
Cap and trade programs have all been utilized for largely the same purpose: low-cost reductions of emissions for meeting environmental objectives. Results of a successful cap and trade program can be measured by the realized emissions reductions, market performance and technological innovation.

U.S. Acid Rain Program Costs Less and Reduced More than Expected

The U.S. Acid Rain Program is the most mature example of how a cap and trade system works to both reduce the cost of compliance and also meet and even exceed environmental targets. The results of the program exceeded even its staunchest supporters' expectations:

- **SO2 Emissions Were Reduced Much More than Required in the first phase of the program (1995-99):** Total emission reductions from affected units during Phase I of the Acid Rain Program were nearly two-times greater than what was required by the caps. Most of these reductions occurred in the first year of compliance, suggesting significant banking of allowances.[11] In all, SO_2 emissions were reduced by 30% more than required during 1995-99, resulting in earlier and greater benefits associated with SO_2 reductions and mitigation of acid rain. [12]

FIGURE 1



Source: EPA

- **Cost Savings and Cost-Effectiveness Were Substantial and Greater than Expected:** In addition to meeting and exceeding the targets early, program costs were much lower than initially forecasted. In 1990, the EPA projected that the costs of the Acid Rain program would approach \$6 billion annually.[13] Other analysts estimated even higher costs. However, in a 2003 report to Congress, the Office of Management and Budget calculated real costs of Phase I had been between \$1.1 -\$1.8 billion per year, representing less than 25% of the estimated EPA

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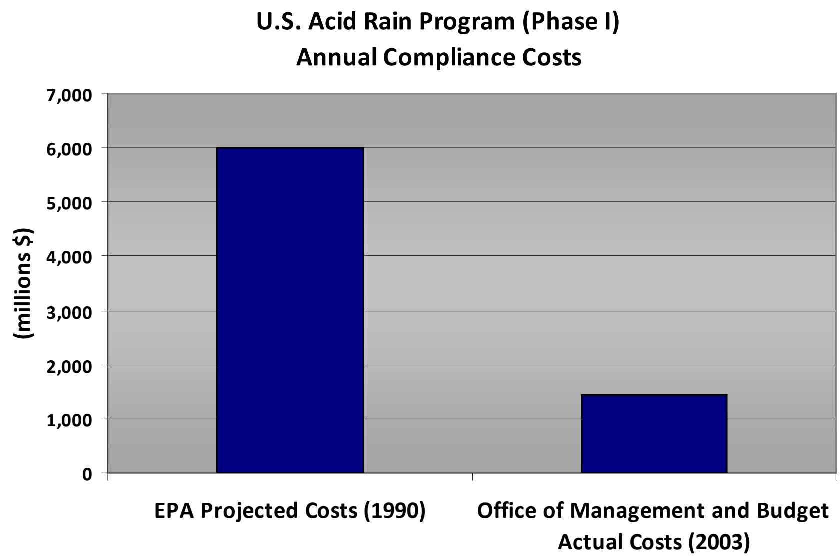
11 The first year of the program saw emissions drop by 3 million tons and emissions were 5 million tons below their 1980 levels during the first 4 years of the program. EPA (1999)

12 EPA (1999)

13 EPA (1989)

costs.[14] Cost savings associated with the Acid Rain program were directly related to trading flexibility. In addition, studies estimated that there had been a large amount of savings due to the trading and compliance flexibility associated with cap and trade systems versus plant by plant emission standards ("command and control"). One such study estimated that emissions trading resulted in net savings of 33% for Phase I and 62% for Phase II.[15]

FIGURE 2



U.S OTC NOx Budget Trading and NOx SIP Call Trading Programs Reduced Pollution at a Low Cost

The OTC NO_x program and subsequent NO_x SIP Call are also successful examples of emissions trading systems in which environmental goals are achieved or even exceeded at a low cost:

- Over the past six ozone seasons, the NO_x SIP Call program significantly lowered NO_x emissions from regulated sources. Indeed, NO_x emissions in 2008 were 9% below the 2008 emissions cap, 62% lower than in 2000 (before implementation of the NO_x SIP Call program), and 75% lower than in 1990.[16]The OTC NO_x program (1999 – 2002) reduced NO_x emissions by over 60% (over twice the targeted NOx reduction of about 30%).[17]

- While it is difficult to determine the actual cost of the OTC NO_x and SIP Call Programs, there is substantial evidence that compliance costs are significantly below EPA's highly cost-effective cut-off of $2,600 per ton. Since 1990, EPA has used $2,000 per ton of reduction ($2,600 in 2000 dollars) as an upper limit for evaluating highly cost-effective NO_x control strategies.[18] Despite that analytical benchmark, once the OTC NOx program established itself at the end of 1999, allowance prices ranged between $600 and $1,700 per ton and have generally been less than $1,000 per ton.[19] In fact, in 2008 allowances traded for $825 per ton in January and climbing as high as $1,400 during the middle of the year before falling to a period-end closing price in November

14 U.S. Office of Management and Budget (2003)

15 Ellerman, Joskow, Harrison (2003)

16 EPA (July, 2009)

17 Napolitano, Stevens, Schreifels, Culligan (2007)

18 Id. at p. 17

19 http://www.epa.gov/airmarkets/progress/docs/otcreport.pdf NOx Budget Program, Progress Report 1999-2002, p. 17

of \$592 per ton. [20] Results of the program also indicated that the largest emitters had the largest relative emission reductions suggesting only the most cost effective to control facilities (typically the largest plants) were pursued.

- Given that a source can choose to buy allowances instead of reducing NO_x emissions, the price of an allowance should indicate the highest cost (the marginal cost) that a source would have to pay to reduce an additional ton of NO_x and is, therefore, an excellent proxy for compliance costs. As a result, the available evidence strongly suggests that OTC NO_x program and NO_x SIP Call compliance costs have been highly cost-effective and are certainly less costly than a "no trading" program would have been, replicating the experience in the SO_2 market.

EU ETS Flexibility Allows Europe to Meet its Emission Targets

The European Union Emission Trading Scheme is the cornerstone of the EU's successful effort to meet its emissions reduction obligation under the Kyoto Protocol. While the ETS cap nominally covers only approximately 40% of the emissions from the EU, the EU carbon market, particularly the flexibility provided by the use of offsets through the Clean Development Mechanism, has allowed the EU member-states to use international offsets to achieve reductions from sectors not covered by the trading program. Recourse to these international offsets allows EU Member States to cover potential mission reduction shortfalls from command and control policies without jeopardizing compliance with the emissions cap.

- Phase 2 of the EU ETS is only in its second year of operation, so it is too early in the program to identify the level of savings it will deliver relative to a command and control approach. However, the initial results of the program are encouraging. Emissions targets for the covered sectors are being met and the presence of a carbon price signal is influencing investment decisions and behavior. According to the European Environment Agency (EEA), recent estimates indicate that EU greenhouse gas emissions decreased in 2008 for the fourth consecutive year and are approximately 6.2% below the Kyoto base-year emissions for the EU-15.[21] While these reduction figures cover both capped and uncapped sectors of the EU economy, the persistent presence of a carbon price signal provides an important foundation for year-on-year emissions reductions that cannot be explained by the recession, environmental taxes or renewable energy mandates[22].

- Critically, while installations covered by the EU ETS have achieved 100% of the reductions required of them under the cap budget, the policies and measures designed to achieve reductions from uncapped sectors of the economy have not succeeded in reducing emissions to the levels that will be required to achieve EU and national targets. For example, emissions from transport continue to increase, despite improvements in vehicle efficiency and policies and measures designed to reduce these emissions.[23] Indeed the EEA notes that "Previous and current EU policies have mainly focused on improving vehicle technology and fuel quality to reduce pressures on the environment. Trends and projections clearly show that these policies have not been enough to succeed in reducing greenhouse gas emissions from transport and that the effect of introduced mitigation measures has been more than offset by increased transport volumes."[24] Furthermore, "Whilst some recent progress has been achieved, the rate of growth [in renewable energy] remains slow and the barriers to growth, across all sectors, remain high in most Member States. Europe is unlikely to reach either the target for the share of electricity from renewable energy sources or the target for the share o f renewable energy in transport."[25]

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20 http://www.epa.gov/airmarkets/progress/NBP_1.html Emission, Compliance and Market Data, July 2009, p. 10

21 http://www.eea.europa.eu/highlights/new-estimates-confirm-the-declining-trend-in-eu-greenhouse-gas-emissions

22 Neilson (2009)

23 Climate for a transport change, European Environment Agency, 2008

24 Id. at p.4.

25 Commission of the European Communities (2009)

- EU Member States whose emissions from sources outside of the cap program threaten their ability to meet their overall emissions obligations are able to purchase international offsets (thru the Clean Development Mechanism established under the Kyoto Protocol) as a mechanism for covering some of the emissions overages. In these instances, the superior environmental performance of the cap and trade market mechanism facilitates the achievement of the overall emissions reduction obligations. Spain, for example, has used the CDM to reduce emissions in the developing world to help meet its Kyoto obligations despite having made almost heroic investments in renewables. [26]

- In terms of market performance and function, EU Allowances have traded in a range reflective of normal volatility that allows producers and consumers to respond rationally to price signals—an essential element of market function. While revelation that the Phase 1 program was structurally oversupplied caused prices to collapse, concern that the carbon market would be prone to excessive volatility as a consequence of excessive speculation or other factors have not been borne out in practice and the emissions trading market has provided covered sources with access to powerful risk management tools at a lower cost than command and control. [27] Price volatility experienced in both European carbon markets and U.S. emissions markets has been no greater than that dealt with regularly in natural gas and power markets and is a natural feature of functioning markets where demand is influenced by factors such as weather, economic growth rates and changes in relative fuel prices. Critically, the flexible mechanisms of offsets, banking, borrowing and potentially a strategic reserve provide significant supply elasticity.

FIGURE 3

Volatility of Selected Commodities 2005-2007 Range in %	
EUA Dec 06 Futures	**27-161 (57)**
EUAs Dec 08 futures	**28-91 (62)**
SO2 spot price (1995-2006)	**8-44**
Natural Gas (Zeebrugge)	**55-138**
Crude Oil (Brent)	**24-32**
Coal (ARA)	**8-22**
Baseload Electricity (Powernext)	**35-96**
Peak Electricity (Powernext)	**42-105**

Source: Ellerman, Denny, Joskow, Paul (2008), Mission Cliat, Caisse des Depots.

NOTE: The figures in parentheses for the two EUA products is the highest observed voltility when the second quarter of 2006 is excluded.

26 Reuters.com: "Spain buys 6 million emission rights from Hungary", Nov 13, 2008

27 "The analysis suggests major benefits from trading as compared to alternative regulations that do not involve trading. For example, one reviewed study shows that nontrading would cost EU member states 79 billion Euros more than perfect trading. In Germany alone, emission trading is expected to lead to cost benefits of between 230 and 545 million Euros." World Wildlife Fund, Powerswitch, http://www.wwf.fi/wwf/www/uploads/pdf/clearingthemist_summary.pdf.

Why Does Cap and Trade Yield Substantial Cost and Environmental Benefits?

As noted, cap and trade programs have demonstrated substantial cost savings and environmental benefits over command-and-control programs such as facility by facility standards and regulations. There are several fundamental reasons for this:

- **Environmental Compliance Flexibility of a Companywide Emissions Cap:** There is an important economic difference between (1) being subject to an overall cap on a company's emissions versus (2) plant by plant standards: an overall cap on a company's emissions gives that company temporal and spatial flexibility. The company can decide "when" and "where" it makes the most economic sense to reduce emissions. An overall cap allows a company to decide which plant or plants and combination of emission controls, fuels and level of operations will meet the cap most cost effectively. Provisions that allow for allowance banking between years provide further flexibility in time by allowing additional reductions to be made and used for future compliance years, when economically optimal.

- **Economic Flexibility Within a Company:** Command and control policies that require individual plant-by-plant or facility-by-facility limits restrict a company often to only one or two choices of compliance options at each plant and they force these choices irrespective of the retrofit difficulty, age, or specific boiler type. Such plant-specific limits also do not provide any flexibility about where or when emission reductions take place and as noted above provide no incentive to plants to reduce emissions more than required, even when it would be cheaper to do so than to reduce emissions by an equivalent amount at another plant. In contrast, an overall emissions cap allows the company to install controls where they make the most economic sense and to reduce emissions more or less than would otherwise be required so long as the overall cap is met. In fact, this is precisely what happened under the acid rain SO_2 trading program with the larger and newer plants installing scrubbers and reducing more than they would have otherwise done under command and control and the smaller and more costly to control units relying on partial fuel switching and other actions to reduce emissions. The analogous flexibility is true with CO_2 and other greenhouse gas emissions.

- **Trading Flexibility Across Companies:** In addition to flexibility introduced by a broad emissions cap rather than individual plant standards, emissions trading offers compliance flexibility (i.e. risk management) across companies and ultimately across the industry sector or economy at large. The resultant broad market creates an emissions price signal that allows for economically rational decision making. For example, a company which has many expensive control units can buy allowances from a company which can reduce its emissions more cost effectively. A common risk-management technique is for companies to agree to buy allowances in future years while an emissions reduction project is underway with the expectation that once emissions are reduced the company will no longer need to purchase other market participants' allowances. Similarly, companies can sell excess allowances to finance emission reduction projects. These examples of "risk management" are a core function of emission markets and represent the kind of "when" and "where" flexibility that provides low compliance costs. There are many of examples of this in the Acid Rain Program as well as in the EU ETS.

- **Emission Offsets Provide Flexibility to Contain Costs:** An essential part of the flexibility of greenhouse gas emission markets is the ability to use emission reductions achieved by sources outside the emissions cap. Under the Kyoto Protocol, offsets are provided through the Clean Development Mechanism and are generated by emission reduction projects in developing countries. Offsets provide a key cost containment mechanism for greenhouse gas emission markets by providing emitters with a lower-cost way to comply with the emissions cap. When analyzing the impact of the ACES bill, the Energy Information Administration found: "GHG allowance prices are sensitive to the cost and availability of emissions offsets and low and no-carbon generating technologies.... Higher allowance prices occur if international offsets are unavailable, particularly if it is also the case that low- or no-emission base load electricity supply technologies cannot be expanded beyond the

Reference Case level.[28] Echoing that view, the Congressional Budget Office found: **"**Allowance prices would be lower if firms were allowed to use more offset credits to meet the bill's compliance obligations and if those offsets were cheaper than the costs of lowering emissions. Under [the ACES] bill the use of offsets lowers the allowance price by about 70%. Doubling the extent to which international offsets could be used in lieu of allowances in each year would decrease the allowance price by about 30% more.[29] As a result of offsets' lower cost, companies can use offsets as a transitional measure to ensure compliance with the cap while new clean energy technologies and emissions reducing technologies are developed and readied for commercial deployment. Offsets, therefore, contribute to the "when" and "where" flexibility that allows a company to decide the most cost effective combination of measures and the best location at which to implement them while avoiding premature retirement and replacement of long-lived productive assets.

- **Competitive Forces Unleashed by Allowance Markets**: Competitive forces created by allowance markets will reduce compliance costs in several definitive ways:
  - (1) Firms that manufacture and sell similar emission reduction technologies are forced to compete not only against each other but also against allowance markets for compliance preference among regulated companies. The U.S. Acid Rain Program and NO_x OTC program are good examples of this. Manufacturers of similar retrofit technology, such as scrubbers or selective catalytic reduction systems, were introduced to competitive pricing pressure associated with allowance markets and the price signal provided by a robust allowance market. Since allowances are authorized forms of compliance in cap and trade programs, regulated companies that would be forced to either install retrofit technology or reduce output under a standards-based approach were able to comply with reduction targets by simply purchasing allowances in the open market from companies that were able to reduce emissions by an equivalent amount at less cost. Furthermore, by employing a strategy of market purchases and allowance banking, companies regulated by a cap had the option of delaying or even forgoing their decision to install retrofit technology where it would have been very costly to do so. Thus, manufacturers of retrofit technology were forced to lower their costs to compete with allowances available on the open market. This phenomenon led to lower than projected costs of scrubbers during Phase I of the U.S. Acid Rain program and contributed to significantly lower overall costs of the program.[30]
  - (2) Allowance markets will create competition between technology options and strategies that are not direct substitutes of each other. Under a standards-based regulatory approach, a company such as Carolina Power and Light (CP&L) in the 1990s would have only been able to consider fuel switching within its fleet, among eastern low-sulfur coals. The high cost of transporting lower-sulfur Powder River Basin (PRB) coal from Montana or Wyoming to the east coast would eliminate the use of PRB as a viable option for such a company. However, in Phase 1 of the Acid Rain Program, railroad rate cuts (mostly attributed to deregulation of the railroad industry) made the transportation of PRB coal to the Midwest more competitive and led to greater emission reductions in the Midwest than would otherwise have occurred. This in turn applied downward pressure to SO_2 allowance prices, driving down the costs of all fuel switching and overall compliance. Also, the price premium associated with low-sulfur Appalachian coal being paid by Midwest utilities collapsed as SO_2 allowance prices were lower in the earlier years of the program than originally projected.[31] The competitive pricing applied to both compliance technology and the SO_2 allowance market in the Acid Rain Program resulted in program costs, on a yearly basis, to be less than 25% of initial projections.

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28 EIA (2009)

29 CBO (2009)

30 Braine (1993)

31 Ellerman, Schmalensee ,Joskow, Montero, Bailey (1997)

- **Competitive market forces foster accelerated innovation in both covered entities and providers of compliance technology:** This innovation leads to lower cost technologies and improvements in fuel use efficiency. Competitive market forces, created through the introduction of emission allowance trading programs and resulting price signals, provide incentives for technological innovation. By competing against allowance prices, a supplier of emissions control technology will face both downward pricing pressure on existing compliance solutions and also encounter pressure to develop more effective, lower-cost compliance technologies. (A similar dynamic should occur in the energy efficiency technology sector.) This was true in both the NO_x trading programs and Acid Rain Program, where emissions capture rates in control technology improved. Also, advancements in generating efficiency and the ability to blend lower-sulfur coal proved to lower costs in the Acid Rain Program. It is expected that an emissions trading component of a greenhouse gas program will apply significant development and pricing pressure on clean-coal technologies such as integrated combined-cycle gasification systems (IGCC) and carbon capture and sequestration (CCS) technologies.

- **A hard cap set on emissions ensures environmental integrity and the success of long-term policy objectives:** Cap and trade programs set a hard, declining cap on emissions providing for certainty in achieving environmental policy objectives. These programs have been unique in achieving virtually 100% compliance with set-forth reduction goals. The flawless record of cap and trade programs achieving emission reduction goals can be explained for several reasons: (1) Market forces, harnessed through a cap and trade program, effectively enforce the emissions caps. The declining nature of emission caps makes current year reductions more economic than additional future year reductions. Also, compliance flexibility provided by market instruments ensures current year reductions are always possible: and (2) Banking of allowances will likely result in more near term reductions beyond required compliance, resulting in more environmental benefits sooner because allowances are likely to become more valuable in the future as the cap declines. This result was the outcome of Phase I of the U.S. Acid Rain Program in which over 40% of total allowances issued in 1995 were banked for future years, indicating significant over-compliance with reduction goals.

- **To date, there have been NO experiences of manipulation in emissions markets:** Critically, because allowances and offsets in a future U.S. cap and trade program would be held, transferred and retired on a government-run registry, the physical holdings of each market participant and the movement of allowances and offsets will be directly observable by regulatory authorities. This additional level of oversight will provide much greater regulatory transparency than is typically the case with other commodities.

Conclusions

The last two decades have seen market-based solutions to environmental problems evolve from theory to prominence. The incentive based framework of cap and trade programs have been proven to provide both the accelerated emissions reductions and low-cost compliance options that mark successful environmental policy. From the introduction of the U.S. Acid Rain program, in which SO_2 reductions were achieved at a quarter of some predicted costs, to the creation of a fully functioning multi-national greenhouse gas reduction program, policy makers continue to rely upon cap and trade programs for solutions to air quality, global warming and humanitarian issues. This reliance has proven to be effective. In the U.S., the release of SO_2 and NO_x into the atmosphere has substantially declined. In Europe, reductions to harmful greenhouse gasses have occurred. Through cap and trade programs, these environmental objectives have been met at the lowest cost of compliance, ensuring prudent economic policy. As the U.S. progresses towards its own greenhouse gas regulatory program it is essential that policy makers understand the importance of providing covered entities the flexibility to achieve emission reductions at the lowest possible cost. It is through a well defined cap and trade program that both environmental integrity and cost effective compliance can be obtained.

This paper represents views of IETA but not necessarily the views of all of its member companies.

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