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ARTICLE: Expanding the Use of Environmental Trading Programs into New Areas of Environmental Regulation

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SUMMARY:
... The Acid Rain Control Program that was adopted in the 1990 Clean Air Act Amendments is the largest environmental trading program enacted so far. ... Most recently, the United States and other nations proposed an environmental trading program for dealing with emissions of greenhouse gases. ... A trading program provides a mechanism for substituting the less expensive alternative. ... As part of the Clean Air Act Amendments of 1990, Congress significantly advanced the use of environmental trading programs by establishing an air emission-trading program to address "acid rain. ... The most comprehensive state environmental trading program is in the Los Angeles area, which, since the 1950s, has had the highest ozone levels in the nation. ... " These credits are essentially akin to buying a stream of credits in an open market air emissions trading program. ... To the extent that a trading system must deal with a pollutant whose effects are directional, the trading program must take directionality into account in any transactions. ... Whether such a quasi-governmental authority could also eliminate the bureaucratic pace and possibly excessive caution of a government agency is an open question. ...

TEXT:
[*87]

Global warming is the most recent, and potentially largest, example of the difficult choices that face environmental policy makers. On one hand, scientists foretell major changes in the earth's climate with extraordinary consequences expected for human civilization and the planet's ecosystems, unless emissions of greenhouse gases are not curtailed. n1 On the other hand, the economies of the developed world depend on fossil fuels, and any major shift away from fossil fuels would be extremely disruptive. n2

New forms of marketable permit systems may offer a means of dealing with such difficult and seemingly incommensurable tradeoffs. Such market-based measures are being increasingly viewed as the answer to the dilemma of how to provide the environmental protection Americans demand at a reasonable cost. The Acid Rain Control Program that was adopted in the 1990 Clean Air Act Amendments is the largest environmental trading program **[*88]** enacted so far. n3 The Acid Rain Control Program, which employs the trading of government-issued certificates that represent emissions of sulfur oxides, has already delivered significant environmental and economic benefits. n4 The question presented in this article is how to obtain potentially greater benefits from transactions where the products being traded are more difficult to value.

Emission reductions from the acid rain program have already surpasssed requirements at a fraction of the cost predicted by many when the program was adopted. n5 Environmental trading programs have become popular in federal legislation, and have been adopted by a number of States in both air and water pollution programs. n6 Most recently, the United States and other nations proposed an environmental trading program for dealing with emissions of greenhouse gases. n7

While trading programs are increasingly common, the volume of trading (except in the acid rain control program) n8 has been surprisingly small. n9 Based on a review of the experience with trading programs, this article identifies the major issues that determine **[*89]** whether trading programs will actually achieve their objectives. This article argues that the "commodity paradigm" that underlies the successful acid rain program is, ironically, the principle impediment to obtaining the full potential benefits of trading. n10 It suggests that to obtain these benefits, a significant effort should be made to develop agreed-upon methods for demonstrating acceptable quality in emission products that will allow extension of environmental trading into the areas where the potential benefits are greatest.

The economic benefits of trading are the result of the differences in the cost of reducing emissions from different kinds of sources - "arbitrage," in economics jargon. n11 For example, it may be far less expensive, on a cost per ton basis, to use low sulfur fuel in two generating units to obtain a given emission reduction than to install a scrubber on one. n12 A trading program provides a mechanism for substituting the less expensive alternative. n13

Environmental trading potentially offers many advantages besides lower costs. Environmental trading programs provide:

. Incentives for those with low compliance costs to reduce their pollution to lower levels than required, and to make the reductions earlier than required;

. An economic stimulus to develop new, less expensive means of meeting environmental standards - by providing a market for technologies that achieve emissions reductions at a cost lower than the market price for credits; and

. A means to eliminate the need for individual variances or exemptions. n14

[*90] Environmental trading can also help lower the decibel level and enhance the rationality in environmental policymaking. Trading establishes a market price for achieving a given environmental goal. With more accurate information about the cost of reaching pollution control goals, policymakers can make more informed policy decisions with respect to such goals. In turn, this will mean there will be less room for the kind of battle of wildly disparate claims that are a staple of today's environmental debates. n15

The larger the benefit, the greater the arbitrage between the trading partners. For example, the current price of publicly traded acid rain allowances which represents the arbitrage available under the currently-applicable control regime, is under $ 200 per ton at this writing. n16

But this arbitrage is small compared to the potential in other situations. As air and water pollution control regulations become increasingly demanding on industrial sources and motor vehicles, the arbitrage between them and the largely unregulated "area" sources has grown increasingly large. n17 Emission reductions from "area sources" of air pollution (small engines, lawn mowers, barbecues, consumer products, and the like), which account for about one-sixth of emissions nationally, have been largely passed up so far. n18 The cost of further incremental nitrogen oxide (NOx) emission controls on automobile engines, for example, are usually estimated at thousands of dollars per ton. n19 NOx reductions from replacing existing gasoline-powered lawn mowers, which have no **[*91]** emission control technology, with electric mowers, which emit no NOx, can be made at a fraction of the cost. n20

In order to consider how such potential benefits might be realized, it is necessary to examine existing trading systems and identify the critical design issues that must be resolved in order to extend environmental trading beyond its current limitations.

I. Existing Trading Programs

In the late 1970s, regulators began grafting crude environmental trading programs onto existing command and control environmental regulatory structures. Since then, trading programs have become more complex. Modern environmental trading programs are increasingly sophisticated, allowing for complex transactions through third party brokers and credit manufacturers. Most remain tightly circumscribed, however, in terms of who may participate and what may be traded. For example, trades involving emissions from industrial facilities, on the one hand, and motor vehicles, on the other, are usually subject to close regulatory supervision or prohibition. Few transactions involving industrial water dischargers and non-point sources of water pollution have been allowed. Transactions involving enhancement of habitat in lieu of changes in industrial practices have been permitted in only a handful of instances. The following is a survey, with some examples, of existing trading programs.

A. Air Programs

Environmental trading programs first appeared in the context of air pollution regulation. n21 It is in this context that their use is most widespread and their evolution most advanced.

1. Federal Air Programs

Air emission trading programs can be traced back to the U.S. Environmental Protection Agency's (EPA) establishment of an air emissions offset policy in 1976 n22 for companies seeking to locate new emission sources in areas classified as nonattainment for a National Ambient Air Quality Standard (NAAQS) under the **[*92]** Clean Air Act. Congress expressly authorized offset programs the following year in the Clean Air Act Amendments of 1977. n23

EPA conceived of the offset policy as a way to bring nonattainment areas into attainment while minimizing the effect on economic growth. n24 Under the offset policy, which has evolved considerably over the years, EPA may authorize an individual company to construct a new major source (or modify an existing one) provided it obtains more than equivalent emission reductions, or "offsets," from existing sources that contribute to nonattainment, and provided that it meets certain other conditions. n25

To date, there have been more than ten thousand approved offset trades, over ninety percent of them in California. n26 From 1985 to 1991, over ten thousand tons of offset, including NOx, particulates and SO<2>, were traded in southern California. n27 Estimated expenditures for the emission reduction credits were approximately $ 2 billion. n28

Following closely on the heels of the offset policy, EPA established its so-called "bubble" policy in 1979, n29 under which emissions trading is allowed among existing units within the same company, either in the form of intra-plant trades or intra-firm trades (i.e. trades between different plants owned by the same firm). Through this mechanism, a firm may meet an emission reduction requirement at one unit by reducing emissions at another. For example, emissions might be reduced from one boiler where control costs are low, rather than at small combustion units required to make collectively equivalent emission reductions.

Closely related to the bubble concept is "netting," which EPA unveiled in 1980. n30 Netting allows a source undergoing modification to avoid "New Source Review" (NSR) n31 if it can demonstrate that net plant-wide emissions would not increase significantly even with the increased emissions from the modified unit.

[*93] As part of the Clean Air Act Amendments of 1990, Congress significantly advanced the use of environmental trading programs by establishing an air emission-trading program to address "acid rain." n32 The acid rain program is a tradeable permit system. n33 Beginning in the year 2000, the Act places a ceiling on total SO<2> emissions from electric utility units. n34 An annual allotment of SO<2> emission "allowances" is awarded each year to each covered unit, equal in total to the overall "cap." n35 A covered utility unit that emits less SO<2> than its allocated allowances can then bank those reductions for later use or sell them to another utility unit with emissions in excess of its own allocation of allowances. n36 Once allocated, allowances have a perpetual life. They may be used at any time after they are allotted. n37 Beginning in 2000, and each year thereafter, a national total of 8.9 million tons of allowances will be allocated each year.

2. State Air Programs

a. RECLAIM

The most comprehensive state environmental trading program is in the Los Angeles area, which, since the 1950s, has had the highest ozone levels in the nation. n38 In 1991, the South Coast Air Quality Management District (SCAQMD), which exercises jurisdiction over the 12,000 square mile air basin surrounding Los Angeles, n39 introduced the concept of a marketable permit program as part of its air quality management plan. n40 By 1993, the program evolved into the Regional Clean Air Incentives Market (RECLAIM). n41

Like the acid rain program, RECLAIM was designed as a tradeable permit program, including phased reductions in allotments **[*94]** of emission allowances over the period 1994 to 2003. n42 RECLAIM was conceived of as an iterative program, with more sources and pollutants to be included each year. n43

RECLAIM's first iteration was in 1994. Trades were allowed among 370 sources of NOx and forty sources of SO<2>, representing approximately seventy percent of stationary source emissions in the Los Angeles basin. n44 Emission rights were allocated based on a baseline of existing emission levels at the time the program was adopted. n45 Each year from 1994 to 2003, sources in the program receive a declining allocation of RECLAIM Trading Credits (RTCs). n46

b. Open Market Systems

In contrast to the "cap and trade" programs, established under the acid rain and RECLAIM projects, several States have adopted "open market" air emission trading programs. n47 In these programs, the number and type of potential market participants is not strictly circumscribed, as under cap and trade programs. n48 Open market programs, which have been enacted in New Jersey, n49 Texas, n50 and Massachusetts, n51 as well as in other states, n52 derived significant conceptual guidance from an Emissions Trading Demonstration Project launched by the Northeast States for Coordinated Air Use Management and the Mid-Atlantic Regional Air Management Association, in the early 1990s (NESCAUM/MARAMA). n53 The project was developed in the context of **[*95]** widespread ozone non-attainment in northeastern states. n54 The NESCAUM/MARAMA project analyzed the potential structure of an open market air emission trading system and developed a set of governing principles and policies for such a system. Several emissions trades were consummated under the auspices of the Demonstration Project, which informed the principles established under the Project. n55

Although the open market trading systems adopted by New Jersey, Texas, and Massachusetts share some basic similarities with both the NESCAUM/MARAMA system and with each other, they differ with respect to important concepts.

All the systems rely on a registry, with mandatory notice filings, to track compliance and to facilitate market transactions. Under the Texas system, for example, a Notice of Generation of emission credits, n56 a Notice of Intent to use such emission credits, n57 and a Report of Use n58 must all be filed with a central registry.

Currently, none of the systems authorize interpollutant trading, such as trading NOx credits to satisfy volitile organic compound (VOC) requirements. Nor do any of the systems authorize the use of credits to comply with the Clean Air Act's technology requirements (BACT, LAER, or NSPS) n59 although the NESCAUM/MARAMA framework contemplates such uses. n60 Use of credits to avoid New Source Review is also prohibited in these State open market systems. n61 The NESCAUM/MARAMA prototype, but none of the State programs, contemplates using credits created by emission reductions from mobile sources to comply with enhanced vehicle inspection and maintenance programs. n62 In short, while emission trading systems are being adopted, the permitted uses of credits are very circumscribed. Credits may **[*96]** only be used to comply with RACT-based emission limitations; to meet offset requirements under the new source review program and, in New Jersey, to meet "alternative emission limits" (effectively, a variance). n63

The open market systems differ over whether to allow credit generation from plant shutdowns or production curtailments. The New Jersey system does not allow credits to be generated from shutdowns or curtailments. The Massachusetts regime does allow for such credit generation, but only if the credits are adjusted for shifting demand and subject to other possible restrictions. The Texas system allows credits to be generated from shutdowns but not from curtailments.

The various open market systems also address the potential for emission "spiking" differently. n64 The NESCAUM/MARAMA group proposes a system of intertemporal trading, allowing trades across ozone seasons, but not allowing trades where the credit is generated outside an ozone season for use during an ozone season. n65 The New Jersey and Texas systems, by contrast, require that all credits generated within an ozone season be used during that same ozone season (credits generated outside an ozone season are also barred from being used during an ozone season). The Massachusetts program allows credits generated during an ozone season to be used at anytime during the calendar year. n66 And the Texas system caps the number of emission credits that may be used at any given time. n67

While the NESCAUM/MARAMA, New Jersey, and Massachusetts systems authorize interstate trading, the Texas system does not. n68 The Texas system restricts intrastate trading as well, while neither the New Jersey nor Massachusetts programs do so. n69 The Texas and Massachusetts programs require users to obtain **[*97]** enough credits to assure a compliance margin, the NESCAUM/MARAMA and New Jersey programs do not. n70

The open market programs also define the products traded differently. The New Jersey program allows trading of NOx and VOC in increments of one-twentieth of a ton of reduction. n71 The Texas system uses increments of one ton for trading in NOx, VOC, carbon monoxide, sulfur dioxide, and particulates. n72 The Massachusetts program permits trading of NOx, VOC, and carbon monoxide in increments of five tons. n73

Each open market program establishes a different mechanism for assuring the quality of the emission credits generated and used. The NESCAUM/MARAMA project took the position that the user should be responsible to demonstrate credit quality to pollution control officials upon use. n74 Thus, it would be the responsibility of the user to conduct sufficient due diligence at purchase to assure that the credits represented real emission reductions in excess of emission control requirements, properly quantified and documented, and allowable for compliance in the state of use. n75 The due diligence would be entirely the prerogative of the private parties to the transaction under the NESCAUM system. n76 It might range from trusting the reputation and/or representatives of the seller to third party audits or observations of the credit creator's process. Whatever the diligence, the buyer would have to convince the State of the quality of the credits.

The New Jersey system takes an alternative track, requiring (1) the credit generator to prove the quality of credits (2) to an independent verifier licensed by the State (3) before the credits are used. n77 Texas combines elements of both the NESCAUM/MARAMA and New Jersey frameworks. n78 Like New Jersey, it requires the generator to prove the quality of emission credits prior to use but, like the NESCAUM/MARAMA system, it also requires the generator to make a showing to a regulatory body. n79 Massachusetts **[*98]** requires both user and generator to receive approval from a regulatory agency before reductions may be credited and used. n80

Thus, each state's program distributes the legal responsibility for credit quality differently. The NESCAUM/MARAMA project proposes user responsibility, making the user liable for assuring the quality of emission credits. n81 The generator would in turn be answerable to the user through normal commercial contract enforcement mechanisms. n82 Under the New Jersey system, the generator has responsibility for demonstrating credit quality. n83

The user is responsible only for complying with certain administrative requirements. n84 New Jersey's system is complicated by the presence of a State-mandated "independent verifier." n85 Although the verifier is responsible for ensuring that the notice is "true, accurate and complete," n86 the scope of the verifier's liability is unclear. Apparently, New Jersey intends to analogize the verifier to an auditor, limiting the verifier's liability accordingly. The Texas program, like that of New Jersey, ostensibly places primary liability for credit quality on the generator. A user in Texas "should ensure" n87 that the credits meet the applicable requirements for purchase. The user must also engage in due diligence to verify that the credits were not generated in an unauthorized manner. n88 Thus, in reality, both creator and user may be answerable to the Texas authorities for credit quality. Finally, the Massachusetts requirement of State pre-certification effectively transfers liability for the quality of credits to the State itself. n89

B. Water Programs

Environmental trading programs are found in two areas of water law: wetlands regulation and effluent trading. n90 All of the **[*99]** Clean Water Act trading systems are open market systems where "credits" are generated by taking environmentally beneficial actions that are not required by law or regulation. n91 None is a "cap and trade" allowance-based system. Trading is more established with respect to wetlands. n92

1. Wetlands Trading

Wetlands are regulated under a complex web of federal and state programs. Section 404 of the Clean Water Act n93 requires permits for activities that adversely impact most wetlands. n94 If adverse impacts on wetlands are unavoidable and wetlands mitigation is not possible on-site, then a permit applicant must find another means to compensate for those adverse impacts.

Since the 1980s, federal and state regulatory agencies have allowed some permit applicants to meet their mitigation requirements by purchasing wetlands "credits" from approved "wetlands mitigation banks." n95 These credits are essentially akin to buying a stream of credits in an open market air emissions trading program.

In general, wetlands mitigation banking works as follows. First, a public or private "bank sponsor" restores, enhances, creates, or (possibly) preserves an area of wetlands in a particular region, watershed, or ecosystem. n96 The value of these wetlands is quantified in some way, and assigned wetlands "credits." n97 The credits are then placed in a "wetlands mitigation bank." n98 From this bank, the credits can be purchased and withdrawn by permittees to mitigate wetlands losses within the same region, watershed, or ecosystem. n99 Typically, banked wetlands credits continue **[*100]** to be generated so long as the wetlands mitigation project continues.

Wetlands mitigation banking has evolved over time, and has become increasingly sophisticated. In 1988, twelve banks had been identified nationally. n100 By the summer of 1992, forty-six such banks had been developed in eighteen states. n101 In 1995, seventy-seven were identified by the Corps of Engineers. n102

Wetlands mitigation banks take three general forms: (a) single-user mitigation banks; (b) public commercial banks, including fee-based mitigation systems ("in-lieu fee systems" or "mitigation trusts"); and (c) private commercial banks involving mitigation credit markets. n103

a. Single-User Mitigation Banks

As the name implies, single-user mitigation banks are developed and used exclusively by a single public or private entity to provide for its own future mitigation needs. n104 The first of these banks came into existence in the mid-1980s as large developers restored, enhanced, or created large areas of wetlands at some other location in the state from which they could derive mitigation credits. n105 Of the forty-six wetlands banks in existence in the summer of 1992, forty were single-user banks. n106 Thirty-four of the banks were developed for public entities, including state highway departments (twenty-two projects in thirteen states), n107 port authorities (five projects), and counties (four projects).

n108

[*101] For example, in 1988, the Idaho Transportation Department established a mitigation bank to compensate for wetlands losses resulting from highway development. n109 The bank consisted of three separate parcels of marsh, wetlands, and dry land over a total of 213 acres. n110 The banked property could be used in mitigation so long as it was within the same watershed, human impact zone, and transportation district as the corresponding highway project. n111 Idaho agencies were responsible for evaluating the bank's wetlands "credits" and "debits" based on functional wetland replacement units determined under Habitat Evaluation Procedures (HEPs). n112

b. Public Commercial Mitigation Banks & Fee-Based Mitigation Programs

In an effort to extend the advantages of wetlands banking to more permit applications, governmental entities created public "commercial" banks. n113 Essentially, these publicly-financed banks offer wetlands mitigation credits for sale to the general public, with proceeds paying for the construction and management of the bank. n114 By 1992, there were five such public commercial banks in operation. n115 In 1995, there were fifteen in operation, with thirty other prospective banks in development. n116

One example of such a commercial bank was established in North Dakota by the State Legislature in 1987. n117 The bank is sponsored by the State, with sites located throughout the state. The goal was to establish a comprehensive agricultural no-net-loss-of-wetlands program; clients principally are farmers throughout the state. n118 In 1992, the bank balance consisted of 4,425 credits, resulting from 5,000 acres of credits and 575 acres of debits from 118 debiting transactions. n119

Similar to public commercial banks are public fee-based mitigation programs, also known as "in-lieu fee systems" or "mitigation **[*102]** trusts." n120 In these programs, permittees meet their mitigation responsibilities through payment of permit compensation fees in lieu of replacing wetlands or obtaining wetlands credits from a bank. n121 These revenues are then accumulated to fund future, and theoretically equivalent, replacement of wetlands by the governmental or non-profit entity. n122

The first fee-based program began in Florida in 1987. n123 Developers of wetlands paid fees to the Florida Game and Fresh Water Fish Commission's Fish and Wildlife Habitat Trust Fund for the purchase and management of large, ecologically significant Mitigation Parks (ranging in size from 400 to 1,500 acres). n124 Fees would differ depending on the amount of wetlands developed and the habitat and species affected. Similar fee-based programs are utilized in Louisiana and Maryland. n125

c. Private Commercial Mitigation Banks

Private commercial banks constitute the latest wave in wetlands mitigation banking. n126 Profit-seeking entrepreneurs create wetlands mitigation banks with private capital and sell mitigation credits to the general public. n127 To date, federal and state regulators have assumed a very large role in quality assurance for such banks. n128 Typically, regulators approve the establishment of the bank, assess the quality and value of the wetlands credits in the bank, and determine whether a bank's credits may be applied to a **[*103]** particular mitigation project. n129 By 1995, nine of twenty-four commercial ventures in operation were privately funded, and twenty-three other prospective ventures had been identified. n130

The first approved private bank was established in 1992 in Millhaven, Georgia. n131 By late 1995, the bank had completed mitigation of approximately one hundred acres and the Army Corps had approved the sale of thirty acres worth of credits under the federal section 404 program. n132

2. Effluent Trading

Effluent trading takes several forms, including trading among point sources and trading between point sources and nonpoint sources (a practice still unusual in air trading programs).

a. Trading Between Point Sources

Effluent trading between point sources began in the early 1980s. These programs involve trades of effluent reduction credits between two or more point source dischargers on the same waterbody. As in open market air emission trading programs, credits are created only when a point source reduces discharges of effluent more than required by the Clean Water Act. In lieu of upgrading its own pollution controls, a source may purchase credits from another facility that has achieved greater reductions of pollutant loads than required by, for example, installing new technology.

Wisconsin created the first such program in 1981. n133 The State allowed trading of biological oxygen demand (BOD) in two rivers - among twenty-one parties along a thirty-five mile stretch of the Fox River, and among twenty-six parties along the five hundred miles of Wisconsin River. Trading, however, has been slow, in part because of severe regulatory restrictions imposed on trades, and in part because of the potential for legal challenge of trading as inconsistent with the Clean Water Act. n134

[*104]

b. Trading Between Point and Non-point Sources

These trading programs contemplate transactions between traditional point sources, such as manufacturing facilities, and "non-point" sources, such as farmers or livestock producers whose practices cause harmful runoffs to the same waterbody. n135 Normally, the non-point pollutant reductions are achieved by employing management practices that effectively reduce non-point pollutant runoff to a waterbody.

In 1997, the Minnesota Pollution Control Agency (MPCA) established some of the more sophisticated policy guidelines for point/non-point pollutant trading. n136 Not only does the guidance allow a point source to offset exceedences of effluent limitations by carrying out non-point riparian enhancements upriver, but it also allows the source to do so by trading different pollutants. n137

For example, the MPCA gave one point source, a brewery, permission under its NPDES permit to discharge additional carbonaceous biochemical oxygen demand (CBOD<5>) effluent to the Minnesota River, provided that it offset the environmentally harmful effects of the additional discharges by reducing phosphorous loadings upriver. n138 The brewery was required to achieve environmentally equivalent reductions through conversion of sufficient farmland to riparian zones and wetlands. The equivalency between CBOD<5> discharges in the lower Minnesota River and the phosphorous loadings upstream was determined based on complex biochemical relationships.

To date, MPCA has approved two trades that will allow the brewing company to offset the CBOD<5> loadings at the plant by reducing non-point phosphorous loadings upriver. In the first, the brewing company purchased forty acres of farmland near the mouth of a tributary to the Minnesota River and is converting it from agricultural use to native vegetation. n139 MPCA has concluded that the conversion will significantly reduce soil erosion and change the land parcel from an area of degradation into an area of aggradation. n140 In other words, the parcel becomes a sink **[*105]** rather than a source of phosphorous-bearing sediment. The second trade involves the brewing company's purchase of a sixty-two acre riparian area, the point of an isthmus that extends into the river. As this parcel is converted from farmland to mixed grass and wooded vegetation, it too becomes an area of aggradation, instead of degradation, and reduces the phosphorous loading on the Minnesota River.

As part of its "reinvention" initiative, the Clinton Administration promoted growth of effluent trading programs, like the one in Minnesota, to achieve further reductions of water pollution. n141 In May 1996, EPA issued its Draft Framework for Watershed-Based Trading. n142 The framework provides a clear presentation of relevant issues and a structured analytical means for examining various state and local effluent trading initiatives.

II. Issues in the Design of Market-Based Transactions Regimes

As Part I described, market-based programs are now common in American environmental regulation. Starting from the EPA offset and bubble policies, which allowed rudimentary trading only in very circumscribed circumstances, trading programs have become increasingly common, particularly under the Clean Air Act. But policymakers remain reluctant to venture beyond trades of emissions of identical substances. The increasing trade in wetlands acreage is an important exception to this rule.

A. Common Design Elements in Trading Systems

There are potentially significant benefits to society in applying market-based regulation more broadly. This section derives a set of considerations with regard to the design of market-based programs that will allow policymakers to consider extending market principles into additional areas of environmental regulation. n143 These considerations exist in any pollution regulatory system. Indeed, this analysis shows that command and control **[*106]** regulation is in fact a special case, and not an opposite from market-based regulation.

This discussion focuses on six issues that a policymaker must address in designing a market-based regulatory system. These include the geographical area included within the trading system, the allowable spatial relationship between parties to a transaction, the types of pollution sources or others who may engage in trading, and issues related to quality assurance and enforceability. "Cap and trade" systems present two unique issues - determining a baseline and allocating emission rights.

1. Determining the Scope and Geographical Extent of the Market

The initial design step, prior to determining whether a trading system can be helpful, must be to identify the resource to be protected and the source of threats to that resource. Once these questions are answered, the policymaker must determine the geographical extent of the market-based system. The concept of a "shed," defined by reference to the resource to be protected, is critical to the design of a market-based regulatory system. n144 The appropriate "shed" would include the entire area that affects the resource in question. Thus, depending on the nature of the resource, the "shed" may range greatly in size. The watershed for a high mountain lake, for example, may be limited to just a few square miles or less. The relevant airshed for addressing acid rain, on the other hand, includes at least the eastern half of the country and part of Canada - the area within which transported acid gas emissions have an affect on forests, soils, lakes, and humans.

2. Geographical Relationship Between Parties

In addition to defining the relevant resource "shed" for purposes of structuring a trading system, a policymaker must also consider the acceptable spatial relationships between trading partners. This involves two issues.

First, there is the proximity of the participants in a transaction to each other and to the affected resources and people. This is relevant to whether there is tolerable equivalence in environmental effect between the emissions or discharges of the generator and user of credits or allowances. For example, if discharges from a **[*107]** paper mill at one end of a long lake do not reach the resort at the other end, then a reduction in biological oxygen demand from the mill should not be able to create credits that can be used to enable discharges into the water at the resort end of the lake. When proximity is ignored, environmental justice issues are often created.

Second, there may be an issue of directionality. Direction of flow, particularly of air or water, often bears an important relation to environmental quality. For example, given the prevailing southwest-to-northeast airflow along the East Coast, reductions in nitrogen oxide emissions in Pennsylvania may improve ozone air quality in New Jersey, but reductions in Connecticut are unlikely to affect air quality in Maryland. An appropriate trading system for nitrogen oxide emissions designed as part of an ozone control program would therefore allow credits created by surplus emission reductions in Pennsylvania to be used by emitters in New Jersey, but would not allow Maryland sources to use credits created by emission reductions in Connecticut.

Not all pollution problems present problems of directionality. For some air or watersheds, the affected resource is sufficiently small that, for practical purposes, any emission or discharge can be considered to affect the entire resource, rather than flowing from one place to another. In the case of acid rain, on the other hand, the National Academy of Sciences suggested that the problem was sufficiently ubiquitous n145 and the sulfur emissions that caused acid rain sufficiently mixed across the eastern United States, so that reductions anywhere within that entire area could be considered roughly equivalent in terms of their effect on the environment. The issue of directionality does not arise in every context, but it is present for many environmental problems where air and water trading programs have been considered.

To the extent that a trading system must deal with a pollutant whose effects are directional, the trading program must take directionality into account in any transactions. Typically, this would be done by either prohibiting "wrong direction" trading, or, where directionality is less clear, by attaching conditions that make such trades less attractive.

[*108]

3. Types of Pollution Sources Permitted to be Traded

The benefits of market-based regulation, like those of product markets, are a function of the size of the market. The greater the percentage of the total emissions included in the market, the lower the average cost of meeting any given regulatory requirement and the greater the other benefits of the market, such as technological innovation. If the architects of a trading system limit the ways salable emission credits can be created, they limit the supply of credits available for sale. If they limit the regulatory requirements that can be met using credits, they limit the demand for credits and undermine the incentive to undertake additional pollution reductions to create credits. Either type of limitation reduces the potential economic and social benefits of trading. n146

So far, air regulators have been reluctant to allow trading among stationary, mobile, and area sources, even though most would admit that allowing such trades would markedly improve the cost-effectiveness of the nation's air pollution control program. It is generally acknowledged, for example, that the cost per ton of additional reductions in NOx emissions from today's new cars is five or more times that of reductions from many stationary sources. Emission reductions from area sources unregulated under the current Clean Air Act program are no doubt substantially less expensive yet.

One key applicability issue is whether emission reductions at sources that are not currently regulated can create emission rights that regulated entities can use for compliance. Air regulatory agencies often place limits on the ability of unregulated **[*109]** sources to create credits. This is largely based on fears about whether the reductions would have occurred anyway, and concerns about verification. However, water regulators take a different view. Essentially all of the "credits" available in most wetland banks have been created by actions taken by unregulated entities to create wetlands from lands that were not regulated as wetlands under the Clean Water Act.

4. Determining a Baseline

For "cap and trade" systems, determining an appropriate emissions or discharge "baseline" is critical to achieving the environmental objective of the program. If halving the concentration of a pollutant in a water body is the objective, other things being equal, a policy to halve total discharges into the water body will be necessary. But these "other things" are often not equal. Unless current discharges are known, it will be impossible to determine how many allowances may be given out in conformity with that policy objective.

The calculation is further complicated where the discharge or emission undergoes chemical or physical transformation in the environment. For example, since tropospheric ozone is the result of complex chemical reactions in the atmosphere involving nitrogen oxides and both natural and manmade hydrocarbons which are driven by the energy of sunlight, a straight-line extrapolation between reductions in emissions of nitrogen oxides and in ozone concentrations significantly oversimplifies reality.

While the baseline concept is easy to grasp in the abstract, in practice it is often impossible to achieve a precise understanding of the reductions in emissions or water discharges needed to achieve a stated air or water quality goal. Our understanding of the complex chemistry of air and water bodies and the diffusion of pollutants is not adequate to allow much precision. For this reason the apparent precision of "cap and trade" systems may often be illusory.

5. Allocation of Emission Rights

The governmental allocation of emission rights is a second major design issue for "cap and trade" emission trading systems. n147 The need to allocate emission rights distinguishes "cap **[*110]** and trade" systems from other market-based pollution control systems such as auctions, open market emission trading systems, or emission taxes. n148 The system for allocating rights, whether explicit or implicit, is analogous to any other government subsidy or grant of rights to resources or other assets. It has significant financial consequences for the regulated entities. As a consequence, it can create significant political stress on the policymakers - enough to dramatically affect the program's economic efficiency in some cases.

It is important to recognize the political nature of the allocation process, because the politics of setting emission limitations is often identified as a criticism of the "command and control" system. But as anyone who has read section 405 of the Clean Air Act (the acid rain allowance allocation scheme) understands, the same forces shape decisions about who gets how much of the air resource allocated to them.

Under the acid rain program and other "cap and trade" programs, a source must possess allowances in an amount equal to its emissions. The allocation of allowances, whether considered a license or a property right, n149 represents a transfer of a value from the government to the regulated entities. In these systems, the transfer is explicit n150 and, therefore, highly politicized. In the acid rain program, in order to minimize political opposition, allowances were allocated with a formula that assured the greatest number went to those who had the highest emissions. The process of allocating nitrogen oxide emissions allowances to states within the northeastern Ozone Transport Region was also highly politicized. In Los Angeles, the logrolling in the RECLAIM allocation process became so extreme that it threatened the viability of the program. As the author has argued elsewhere, in such a politicized process, the temptation to solve political problems by creating additional allowances is almost irresistible. n151

[*111] The allocation of emission rights in a "cap and trade" system does not necessarily have to be done according to previous emissions, as it was (roughly) in the acid rain program and the Ozone Transport Region's state allocations. For example, a "Generation Performance Standard" (GPS) has been suggested for use in the regional NOx emissions control program that has been proposed by EPA. n152 Under this concept, allowances would be allocated by reference to the electricity generated by a unit rather than by reference to the pollution emitted in a base year. n153 To determine the GPS, the regulatory body would determine the total emissions that could be allowed, consistent with the environmental objective. n154 This total would then be divided by the total electricity generated in the base year, to establish an emission rate, which would then become the GPS. n155 Under the GPS proposal, each regulated generating unit would be subject to the same standard. The same GPS would apply to every unit, regardless of the unit's previous emission rate. In order to be sure that the GPS was in fact achieving the emission reductions expected, the regulatory agency would periodically reexamine the actual electricity generation. n156 If total generation exceeded the amount assumed in the original GPS calculation, the GPS would be recalculated in the same manner as the initial calculation, dividing the desired total emissions by the increased amount of generation. The resulting tighter emission limitation would then become the revised GPS. n157

In an open market system, credits are created by investments that reduce emissions below the current emissions or the applicable emission limitation, whichever is less. n158 This is a fundamental tenet of the open market paradigm developed in the NESCAUM/MARAMA demonstration project, n159 and incorporated in the open market air regulations adopted by a number of states. n160 Wetland banks are built on the same principle - wetlands credits are created by investing in actions that create wetlands **[*112]** or restore wetlands that currently do not perform the ecological functions of a healthy wetland. n161

As the author has noted elsewhere, since open market systems do not have an allocation process, they are not subject to the political logrolling associated with "cap and trade" systems. n162

6. Quality Assurance

Since emission trading allows one source to emit or discharge more than otherwise allowed by law, a major design issue for such systems is the mechanism for insuring the credits (or allowances) proffered to make up for the excess emissions or discharges actually representing the emission or discharge reductions claimed. This issue involves two questions: (1) to what extent is it possible to measure accurately either the emission reductions that create the credits (or free up the allowances) or the emissions that use them; and (2) what structure will assure to an acceptable degree that the seller of credits (or allowances) is representing truthfully the emission or discharge reductions beyond requirements that are alleged to create the credits (or allowances).

For purposes of this discussion, the policy responses to these questions can be summarized into two market paradigms: the "commodity paradigm," and the "product paradigm." Those who subscribe to the commodity paradigm picture the environmental trading system in commodity or even currency trading terms. Thus, they picture trading essentially in terms of transactions involving identical, fungible quantities of standard value. In the acid rain program, for example, the buyer of allowance receives government issued paper that allows the buyer to emit an indicated number of tons of SOx. n163 In this system, standardized measurement techniques are imposed by the government as a means of establishing allowance quality. n164 In such a market, transaction costs are minimized. But such a market is of limited use, because relatively few situations offer the needed uniformity. The commodity paradigm does not apply, for example, whenever distance or directionality matter - which is the majority of pollution situations. n165

[*113] [lc5d,]The product paradigm begins with the notion that a broad universe of actions that reduce emissions should be capable of creating tradeable credits. In this paradigm, an entity that reduces emissions to below an applicable emission limitation or current emissions, whichever is lower, can create an emission "product" that it can sell. n166 Rather than all being identical, however, these products have varying bundles of attributes, for example, the relationship in time and space to the user, type of measurement, and credibility of the creator.

[lc5d,]Rather than a single government-prescribed means of assuring credit quality, the product paradigm assumes a variety of policy instruments to control credit quality, varying from regulations through guidance documents to individual "comfort letters." n167 Rather than assuming that direct enforcement is sufficient to prevent dishonest trading, the government may use elements of the private marketplace, such as private auditors and attorneys employed by buyers, to interpret government policy and advise their clients how to assure their credits are marketable and will be accepted by government as genuine. n168

[lc5d,]Quality control issues have often been oversimplified, as if they were binary in nature. Thus, a system, it is sometimes implied, either does or does not assure that trades fully protect the public interest. But the notion of "quality assurance" may be a more appropriate concept here. This notion recognizes that certainty is not possible. Instead, it focuses on the balance between the degree of certainty on the one hand, and the benefits that flow from trading on the other.

[lc5d,]An analogy to the credit practices of banks may illuminate the point. Consider two hypothetical banks with different policies toward granting credit. Bank Number One provides credit only to a select group of customers who

meet strict accounting criteria, and agree to provide quarterly financial reports to the bank detailing their financial transactions. Bank Number Two issues credit cards to virtually any customer, and provides loans based on a relatively simple net-worth form, supplemented with routine credit checks at the time the loan is made.

[lc5d,]There can be little doubt that Bank Number One will have fewer loan defaults than Bank Number Two. On the other hand, it seems equally certain that Bank Number One will pay for its **[*114]** enviable record on loan defaults by drastically limiting its clientele. Bank Number Two, in contrast, has accepted that its approach to banking will produce a greater number of loan defaults, but balancing the value of the much greater banking business it can capture, has decided that the additional defaults are acceptable. Everyone knows there will be a few deadbeats, but given the benefits of a worldwide financial credit system, there is sufficient quality control. Insurance and other means are available to limit the risks inherent in the system.

The designers of emission trading systems face quality assurance issues analogous to those faced by the two banks in the hypothetical described above. Quality assurance is necessary for a trading system to work. On the other hand, each degree of certainty is purchased at the price of limiting the benefits of the trading system.

Thus, for example, the certainty supplied by the elaborate stack-testing program of the acid rain trading system cannot be duplicated for emission sources that have no stacks. While EPA rhetoric usually fails to acknowledge this trade off, the agency often adopts or supports trading systems in both air and water pollution contexts that accept less rigid quality assurance systems than that of the acid rain program in order to obtain the benefits of trading. For example, EPA recently proposed a "self-certifying process" for a trading system that is part of a proposed regulation to set low sulfur standards for gasoline. n169

III. Extending Trading Programs Into Environmental Regulation

In the previous section, the issue of quality control was identified as the fundamental limitation on the expansion of environmental trading. Today, the largest potential benefits from environmental trading are available from transactions involving unregulated, or little-regulated, sources. For air pollution, these include: (1) small "area sources," such as small boilers, outboard motors, lawn mowers, weed whackers, etc.; (2) consumer products such as hair sprays; and (3) practices that use energy inefficiently. n170 For water pollution, "non-point" discharges from agricultural **[*115]** land, urban runoff and water use practices have the potential for substantial arbitrage with the industrial and municipal dischargers who are already subject to significant regulation. These unregulated, or little-regulated, sources share characteristics that make direct command and control regulation unlikely to be successful: they are individually small, but very numerous; and attempting to regulate them risks political backlash because it would directly affect large segments of the public. n171 Also, in most cases, measuring emissions or discharges directly is difficult, impossible and/or prohibitively expensive.

In some cases involving these kinds of sources, a transaction can only be conducted in the metric of environmental quality rather than the intermediary of emissions or discharges. Examples include the Minnesota PCA's agreement to allow upriver reductions in phosphorous loadings to be used to authorize higher biological oxygen demand at a downstream brewery. n172 Another is the New Jersey DEP's decision to allow restoration of ten thousand acres of wetlands rather than insisting on construction of a cooling tower on the Salem nuclear power plant. n173

To reap the potential benefits of low cost reductions in pollution from these sources, incentive-based regulation is essential. Thus it becomes critical to develop an acceptable quality control regime to allow transactions to occur between such sources and the heavily regulated industrial and motor vehicle sector.

This regime will not be supplied by the commodity paradigm, because it is too rigid. In that paradigm, quality control is accomplished by drastically limiting the acceptable means of demonstrating that the quantities being sold and used are the same as smokestack monitoring. Thus, the commodity paradigm is self-limiting to trades involving sources with smokestacks that can be monitored. It drastically limits society's ability to obtain the benefits of environmental trading because it cannot accommodate the transactions that have the greatest arbitrage.

What is needed is a paradigm that can deal flexibly with quality control issues in order to facilitate trades involving the greatest **[*116]** arbitrage. Like a product market, it would accommodate the many varied bundles of attributes from credits produced from non-industrial sources. The objective of the paradigm should be to obtain acceptable accuracy in determining decreases in emissions or discharges associated with environmental trades. A concept of acceptable accuracy allows for error in any given transaction, so long as the inaccuracies are not biased in one direction. n174 Acceptability is a concept that balances the social benefits of trading and the emission reduction losses caused by crediting lesser quality credits.

Those who have doubts about taking such a "product" approach often raise two important points. First, they point out that errors in quantifying credits for trading in an environmental trading system are not likely to be random. Companies have a financial incentive to overestimate their "overcontrol" of emissions or discharges, claiming more credits than they should; or to underestimate the emissions or discharges in excess of relevant limits, thus using fewer credits than they should. This is certainly true, but what it suggests is that any workable system will need to take on the issue of bias directly. A detailed review of these issues in the open market context was undertaken in the NESCAUM/MARAMA demonstration project, n175 where representatives of state government, industry, and the environmental community worked through the issues identified above, with particular attention to the quality control issue. n176

Several structural means to provide quality control within the product market paradigm have been suggested by the NESCAUM/MARAMA demonstration project and others. Some have suggested that making the user of credits responsible to the government for the quality of the credits used would assure acceptable quality. n177 To provide buyers with assurances, they argue that a private auditing and legal advisory system would grow up and would, as it has in the case of the Securities and Exchange Commission regulation or the income tax system, assure acceptable quality control.

[*117] Some distrust this view because they fear collusion between buyer and seller. They suggest alternatives that would require third party participation in transactions. Thus, the New Jersey open market system requires State-licensed verifiers to examine and approve claimed emission credits before they can be sold.

Another approach would use private purchasing entities, whose business reputation and interest in long term participation in the market provide strong incentives to assure the quality of any credits purchased. While air regulators have been reticent to use it, this approach has been used in the open market context of wetlands banking, mentioned previously.

Yet another approach would be to create an independent governmental purchasing authority, along the lines of quasi-independent water and sewer authorities, which would verify the quality of credits. This approach is commonly used for wetlands banking, and is now being urged in southern California for air credits. n178 Such a public authority could be financed through a revolving fund using funds from general tax revenues or a special tax levied on emitters. It could use these funds to create a bank of credits by, for example, providing financial inducements for homeowners to replace old gasoline-powered lawnmowers with new electric or catalyst-equipped models. Alternatively, the authority could be allowed to fund itself by selling credits, then using the resulting fund to pay for actions that reduce emissions by a greater amount. Over time, the authority should be able to "retire" a significant amount of credits, thereby contributing to improved air quality - in effect, contributing the arbitrage to the public in the form of better air quality.

Proponents of this approach believe that by placing the quality assurance function in the hands of a public agency, it would eliminate the potential for bias and self-dealing inherent in private quality assurance. Whether such a quasi-governmental authority could also eliminate the bureaucratic pace and possibly excessive caution of a government agency is an open question.

In addition to the bias argument, some argue that the transaction costs associated with quality assurance of credits will hobble trading. Those who raise this point often fail to identify their assumptions. **[*118]** Without question, potential traders do take transaction costs into account, and will only trade if the arbitrage available exceeds the transaction costs. The acid rain program has extraordinarily low transaction costs, but SO<2> allowances also offer a rather small arbitrage of less than $ 200 per ton at this writing. It is clear that substantially greater arbitrage is available for NOx and other pollutants in many places, particularly if trading between industrial and area sources is permitted.

Transaction costs will certainly fall as government agencies become more comfortable with transactions that go beyond the commodity or currency-trading model. But even at the current levels, transactions in NOx emissions have been occurring at prices below $ 1000 per ton. n179

In a product paradigm market structure, credit quality is an attribute of the credit "product," which affects the price. n180 The quality of the demonstration becomes an issue between the buyer and seller, with government supervision or third party involvement, not just a matter between each party and the government. In such a market, credit consumers weigh the qualities of products with different attributes, not just the cost of identical items. Credit quality becomes a competitive factor in the market.

Thus, the next stage in the development of trading is the refinement of trading concepts to provide wider opportunities for the creation and use of credits. While the commodity trading paradigm embodied in the acid rain program has received much of the attention, a more flexible product paradigm has been growing alongside it which offers the opportunity to capture far more of the potential economic and other benefits of trading. This product paradigm has begun to provide a mechanism for transactions between highly regulated industrial sources and unregulated or little regulated "area" sources. It can also be used for transactions where environmental quality is the metric, rather than emissions or discharges. Reaching this next stage will require further development of structures to provide quality assurance and limit the potential for bias. It will also require regulators to accept a broader range of credit creation strategies and uses than they have in the past. It also demands a clear-eyed assessment of the quality assurance under today's command and control system, compared with the protections that can be built into market structures.

Legal Topics:

For related research and practice materials, see the following legal topics:
Environmental LawAir QualityNational Ambient Air Quality StandardsEnvironmental LawAir QualityNonattainment AreasEnvironmental LawAir QualityPrevention of Significant Deterioration

FOOTNOTES:

n1. See generally World Bank, Global Climate Change Home Page, at http://www- esd.worldbank.org/cc/ (last modified Dec. 14, 2000) (provides background information on the global climate change issue).

n2. It is not difficult to identify many such dilemmas in environmental policy where the cost of any given level of environmental quality improvement could be reduced if workable market mechanisms can be devised. The Environmental Protection Agency (EPA) recently proposed, for example, that States employ a "cap and trade" mechanism in the nitrogen oxide (NOx) emission control program that is being required of States in the eastern half of the country. See Proposed Rules, EPA *63 Fed. Reg. 56,356* (Oct. 21, 1998). A similarly intractable situation is posed by the current argument about protecting estuarine life from the effects of power plant cooling systems.

n3. See generally Paul L. Joskow & Richard Schmalensee, The Political Economy of Market Based Environmental Policy: The U.S. Acid Rain Program, *41 J.L. & Econ. 37 (1998).*

n4. See U.S. EPA Pub. 430-R-98-012, 1997 Compliance Report: Acid Rain Program (1998) [hereinafter Acid Rain Program].

n5. See id. According to the EPA, the 423 units subject to the program emitted 4.77 million tons of SO<2> in 1997, twenty-three percent less than the allowable level for the year. Meanwhile the price of emission "allowances" remained below $ 200 per ton, a fraction of the predictions made by some when Congress was considering the legislation. See id. at 8. See also Dallas Burtraw, Cost Savings, Market Performance, and Economic Benefits of the U.S. Acid Rain Program, Resources for the Future Discussion Paper, 98-28-REV (September 1998). But see Anne E. Smith et al., The Cost of Reducing SO<2> (It's Higher Than You Think), Pub. Util. Fort. (May 15, 1998); A. Denny Ellerman et al., Emissions Trading Under the U.S. Acid Rain Program: Evaluation of Compliance Costs and Allowance Market Performance, Mass. Inst. Tech. Center for Energy and Envtl. Policy Research (1997).

n6. See generally Acid Rain Program, supra note 4.

n7. See Non-Paper on Principles, Modalities, Rules & Guidelines for an International Emissions Trading Regime, U.N. Framework Convention on Climate Change, 8th Sess., Agenda Item 8, U.N. Doc. FCCC/SB/1998/MISC.1/Add.1 (1998), available at http://www.unfccc.int/resource/docs/1998/sb/misc01a1.htm (Canada on behalf of Australia, Iceland, Japan, New Zealand, Norway, Russian Federation and the United States of America submitted this report).

n8. See Acid Rain Program, supra note 4. According to EPA, 7.9 million SO<2> allowances were traded between unaffiliated entities in 1997.

n9. See Robert Hahn & Robert Stavins, Incentive-Based Environmental Regulation: A New Era from an Old Idea? *18 Ecology L.Q. 1, 16 (1991).* For example, the Michigan emission-trading program ended 1998 with a total number of trades for the year of only 20. In many cases, trading is actually prohibited between those with the highest and lowest marginal costs of pollution reduction. See generally Energy Argus, Inc., Air Daily, 1, 9

(Nov. 10, 1998) available at http://www.energyargus.com/ad. htm.

n10. See Richard E. Ayres, A Market In Emission Credits Incrementally: An "Open Market" Paradigm For Market-Based Pollution Control, 25 BNA Envtl. Rep. 1522 (1994).

n11. See id.

n12. See id.

n13. See id.

n14. The recent shortages of electricity in California have demonstrated this strength. The use of higher-emitting "peaking" electronic generating plants has produced emissions in excess of the allowances available in southern California's "RECLAIM" program. Under such circumstances, command and control systems invariably resort to issuing variances, in effect simply accepting the additional public health risk posed by excessive emissions. The logic of markets, however, demands "repayment" for the allowances "borrowed" by the excessive emissions. Because of the market based RECLAIM program, air pollution officials have been able to require the utilities to fund efforts to mitigate the public health risk associated with the excess emissions.

n15. See Hahn & Stevens, supra note 9, at 12, 13. Hahn and Stevens provide a shorter list of benefits from "incentive-based" regulation: (1) lower cost; (2) improve international competitiveness [seemingly a subcategory of (1), above]; (3) incentives to develop new pollution control technologies; (4) make the terms of the environmental debate more understandable to the general public. See Hahn & Stevens, supra note 9, at 12, 13.

n16. See Ellerman et al., supra note 5. Even with such relatively small arbitrage, impressive economic savings accrue. A careful analysis of one of the earlier years of the system's operation, 1995, when allowance prices were less than $ 100, concluded that the trading program saved twenty-five to thirty-four percent of the cost of a command and control system, or about $ 225-375 million. See also Acid Rain Program, supra note 4 (The EPA estimates annual savings of $ 2.3 to 3.8 billion in Phase II of the acid rain program, which began in the year 2000).

n17. See U.S. Envtl. Prot. Agency, Nonroad Engine and Vehicle Emission Study-Report 104 (1991) [hereinafter Vehicle Emission Study].

n18. See id. A 1991 EPA Report to Congress estimated that non-road engine emissions of NOx amounted to fourteen percent of total NOx emissions, exceeded only by on-highway engines and electric generation. See id.

n19. For example, EPA estimated that the cost-effectiveness of its proposed "Tier II" auto emission standards would be $ 1,748 ("long-term") to $ 2,134 ("near term"). See Proposed Rules, EPA *64 Fed. Reg. 26,004, 26,073* (proposed May 13, 1999). See also Smith et al., supra note 5.

n20. See Vehicle Emission Study, supra note 17.

n21. See Emission Offset Interpretative Ruling, 40 C.F.R. pt. 51 (1999).

n22. See id.

n23. Clean Air Act (CAA) 173, *42 U.S.C. 7503* (1994).

N24. See generally id.

n25. See Emission Offset Interpretative Ruling, 40 C.F.R. pt. 51.

n26. See Robert C. Anderson et al., U.S. Envtl. Prot. Agency, The United States Experience with Economic Incentives in Environmental Pollution Control Policy, 6-2 (1997).

n27. See id. at 6-4.

n28. See id.

n29. See *44 Fed. Reg. 71,780* (Dec. 11, 1979).

n30. *40 C.F.R. 51.166(a)(1)(vi)(A) (1999)*.

n31. *40 C.F.R. 51.307 (1999)*. NSR requires a review of the air quality impact of the changes being made, and the installation of "Best Available Control Technology" (BACT).

n32. CAA 403-405, 40 C.F.R. pt. 73 (1999).

n33. See CAA 403-405.

n34. See id.

n35. See id.

n36. See id.

n37. See CAA 403-405, 40 C.F.R. pt. 73.

n38. Houston passed Los Angeles for this distinction for the first time in the summer of 1999.

n39. See generally AQMD, South Coast Air Quality Mgmt. Dist., http://www.aqmd. gov (last modified Feb. 22, 2001).

n40. See John P. Dwyer, The Use of Market Incentives in Controlling Air Pollution: California's Marketable Permits Program, *20 Ecology L.Q. 103 (1993).*

n41. See South Coast Air Quality Mgmt. District Rules 2000-2015 (1993), available at http://www.aqmd.gov/rules/html/tofc20.html [hereinafter SCAQMD].

n42. See id.

n43. See id.

n44. See Anderson et al., supra note 26, at 6-9.

n45. See id.

n46. See SCAQMD, supra note 41, Rule 2002 ("Allocations for Oxides of Nitrogen (NOx) and Oxides of Sulfur (SOx)").

n47. See Ayres, supra note 10.

n48. See id.

n49. See N.J. Admin. Code tit. 7, 27-30.1 (1996).

n50. See 30 Tex. Admin. Code 101.29(d) (West 1997).

n51. See Mass. Regs. Code tit. 310, 7.00 app. B (1993) (amended 1998).

n52. Michigan, for example, enacted an open market air emission-trading program in 1986. See Mich. Admin. Code r. 336.2201 (1986). The EPA, however, forced Michigan to rework substantial parts of the program, thereby jeopardizing it. Proposed Rules, EPA *62 Fed. Reg. 48972* (proposed Sept. 18, 1997).

n53. See The Northeast States for Coordinated Air Use Mgmt. & Mid-Atlantic Regional Air Mgmt. Ass'n, Emmissions Trading Demonstration Project Phase III (1996) [hereinafter NESCAUM/MARAMA]. NESCAUM is an association of State air quality directors from each of the New England States, New York and New Jersey. MARAMA is an association of State and local air quality directors from Pennsylvania, New Jersey, Delaware, Maryland, Virginia, North Carolina and the District of Columbia. See id. at iii n.2.

n54. See id. at i-ii.

n55. See id. at 1-8. The trades have achieved nearly 14,500 tons of voluntary NOx and VOC reductions during the summer ozone season, and 4,000 tons of voluntary NOx reductions outside the ozone season. See id.

n56. See 30 Tex. Admin. Code 101.29(d)(3)(C) (1997).

n57. See id. 101.29(d)(4)(F) (1997).

n58. See id. 101.29(d)(4)(G)(ii) (1997).

n59. See CAA 182.

n60. See NESCAUM/MARAMA, supra note 53, at 3-3.

n61. See N.J. Admin. Code tit. 7, 27-30.1; 30 Tex. Admin. Code 101.29 (d); Mass. Regs. Code tit. 310, 7.00-app. B.

n62. See sources cited supra note 61.

n63. See NESCAUM/MARAMA, supra note 53, at 2-11, 2-18.

n64. 40 C.F.R. pt. 63, App. A. "Spiking" is a term used to identify a concern that if credits may be "banked" for later use, a number of emitters could simultaneously withdraw them from the bank on a hot day during an air pollution episode, to allow increased electricity generation. The fear is that this will cause an emissions "spike" at precisely the time when pollution loadings in the atmosphere are already excessive.

n65. See NESCAUM/MARAMA, supra note 53, at 1-7.

n66. See Mass. Regs. Code tit. 310, 7.00.

n67. See 30 Tex. Admin. Code 101.29(d).

n68. See NESCAUM/MARAMA, supra note 53, at 1-3. See also Anderson et al., supra note 26, at 6-11, 6-12.

n69. See Anderson et al., supra note 26, at 6-11, 6-12. Given the differences in physical extent of Texas and the two Northeastern States, there may be effectively more similarity among these systems than it might appear from the regulations.

n70. See NESCAUM/MARAMA, supra note 53, at vi-vii. See also Anderson et al., supra note 26, at 6-11, 6-12.

n71. See Anderson et al., supra note 26, at 6-11.

n72. See id.

n73. See id.

n74. See NESCAUM/MARAMA, supra note 53, at 2-9.

n75. See id. at 2-16. (e.g., the reductions were undertaken in the proper season and are not from prohibited types of sources).

n76. See id.

n77. See N.J. Admin. Code tit. 7 27-30.10 (emphasis added).

n78. See 30 Tex. Admin. Code. 101.29(d).

n79. See id.

n80. See Mass. Regs. Code tit. 310, 7.00.

n81. See NESCAUM/MARAMA, supra note 53, at vi-vii.

n82. See id.

n83. See N.J. Admin. Code tit. 7 27-30.1.

n84. See id.

n85. Id.

n86. Id.

n87. 30 Tex. Admin. Code 101.29(d)(4)(H)(i).

n88. See id.

n89. See Mass. Regs. Code tit. 310, 7.00, Appx. B(3).

n90. See generally Inst. for Water Resources, Water Resource Support Center, U.S. Army Corps of Eng'rs, IWR Rep. 92-WMB-1, Nat'l Wetland Mitigation Banking Study, Wetlands Mitigation Banking Concepts [hereinafter WMB-1] (1992); see also Anderson et al., supra note 26.

n91. See WMB-1, supra note 90.

n92. See generally Anderson et al., supra note 26, at 6.2-6.3.

n93. Specifically, section 404 requires permits for activities involving the "discharge of dredge or fill material" into "waters of the United States," which includes most wetlands. *33 U.S.C. 1344*(a) (1994).

n94. See 40 C.F.R. pt. 122 (1999).

n95. Inst. for Water Resources, Water Resources Support Center, U.S. Army Corps of Eng'rs, IWR Rep. 94-WMB-3, Nat'l Wetland Mitigation Study, Expanding Opportunities for Successful Mitigation: The Private Credit Market Alternative 9 (1994) [hereinafter WMB-3].

n96. See id. at vii.

n97. Credits are derived in terms of either (1) a functional evaluation of habitat values or similar wetlands values, or (2) acreage of different types of wetlands (e.g., forested freshwater or forested saltwater).

n98. See WMB-3, supra note 95, at vii.

n99. See id. at vii.

n100. See WMB-1, supra note 90, at 7.

n101. See Inst. for Water Resources, Water Resources Support Center, U.S. Army Corps of Eng'rs, IWR Rep 92-WMB-2, Nat'l Wetland Mitigation Banking Study, Wetland Mitigation Banking: Resources Document 2

(1994) [hereinafter WMB-2]; see also Inst. For water Resources, Water Resources Support Center, U.S. Army Corps of Eng'rs, IWR Rep. 94 -WMB-6, Nat'l Wetland Mitigation Study, Wetland Mitigation Banking 4, 131-134 (1994) [hereinafter WMB-6].

n102. See Inst. For water Resources, Water Resources Support Center, U.S. Army Corps of Engineers, King and Assoc. and Inst. for Water Resources, IWR Rep. 96-WMB-9, Nat'l Wetland Mitigation Study-Commercial Wetland Mitigation Credit Ventures: 1995 Nat'l Survey 5 (1996) [hereinafter "WMB-9"].

n103. See WMB-3, supra note 95, at 12-15.

n104. See id. at 13.

n105. See id.

n106. See id.; see also WMB-2, supra note 101, at 2.

n107. See WMB-6, supra note 101, at 4, 131-134. Nearly one-half of existing wetlands mitigation banks have been established by state highway departments to mitigate against losses caused by highway construction. See Anderson et al., supra note 26, at 32.

n108. See WMB-2, supra note 101, at 78-83.

n109. See id. at 29.

n110. See id. at 27-28.

n111. See id. at 28.

n112. See id. at 27-32.

n113. See WMB-3, supra note 95, at 13.

n114. See id.

n115. See WMB-2, supra note 101, at 78-83. This includes banks that had both public and private clients.

n116. See WMB-9, supra note 102, at vi, 7-15.

n117. See WMB-2, supra note 101, at 63-65.

n118. See id.

n119. See id.

n120. See U.S. EPA, Federal Guidance on the Use of In-Lieu-Fee Arrangements for Compensatory Mitigation Under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act, available at http://www.epa.gov/owow/wetlands/regs/inlieufee.pdf (November 7, 2000).

n121. See id.

n122. In allowing such "borrowing" against future mitigation, the mitigation banks differ sharply from any of the current air emission trading programs, which allow no "borrowing" against future emission reductions.

n123. See WMB-2, supra note 101, at 96; See also Inst. for Water Resources, Water Resources Support Center, US Army Corps of Eng'rs, IWR Rep. 94-WMB-5, Nat'l Wetland Mitigation Banking Study, An Examination of Wetland Programs: Opportunities for Compensatory Mitigation 68 (1994) [hereinafter WMB-5]; see also WMB-9, supra note 102, at 6-7.

n124. See WMB-9, supra note 102, at 5; see also WMB-5, supra note 123, at 68.

n125. See WMB-9, supra note 102, at 22-24; see also WHB-2, supra note 101, at 33-40.

n126. See generally WMB-9, supra note 102.

n127. See generally id.

n128. See Federal Guidance for Establishment, Use and Operation of Mitigation Banks, *60 Fed. Reg. 58605* (Nov. 28, 1995), available at http://www.epa.gov/OWOW/ wetlands/mitbankn.html (revised Aug. 21, 1997).

n129. See id.

n130. See WMB-9, supra note 102, at vi, 7-12 (including Table 1).

n131. See id. at 10.

n132. See id.

n133. See Wis. Admin. Code ch. NR 212 (Sept. 2000).

n134. See Anderson et al., supra note 26, at 6-29; see also Office of Water and Policy Planning and Evaluation, Envtl. Protection Agency, The Benefits and Feasibility of Effluent Trading Between Point Sources: An Analysis In Support Of Clean Water Act Authorization (1993).

n135. See Anderson et al., supra note 26, at 6-31. While point/non-point trades are considered acceptable in the context of the Clean Water Act, they are generally not seen as acceptable under Clean Air Act trading programs.

n136. See Norman Senjem, Water Quality Discussion, Minnesota Pollution Control (1997).

n137. See id.

n138. See id.

n139. See id.

n140. See id.

n141. See U.S. Envtl. Prot. Agency, President William Clinton and Vice President Al Gore, "Reinventing Environmental Regulation": Clinton Administration Regulatory Reform Initiatives (Mar. 16, 1995), http://www.epa.gov/opeihome/rpubsinfo/march16 1995.htm.

n142. See Office of Water, Envtl. Protection Agency Pub. 800-r-96-001, Draft Framework for Watershed-Base Trading (1996).

n143. See id. at ch. 2 (lists "Principles for Trading").

n144. See id. at 2-8 (the importance of this concept is recognized).

n145. See, e.g., Henry A. Waxman, Overview and Critique: An Overview of the Clean Air Act Amendments of 1990, *21 Envtl. L. 1721, 1790 (1991)* (citing several major reports by the National Academy of Science).

n146. The recent shortages of electricity in California have shown why it is important to include many different kinds of emissions sources in emission markets. Southern California's RECLAIM market for emissions of sulfur and nitrogen oxides, as described above, includes only a few hundred sources, with the bulk of the RECLAIM allowance being used by electric generating stations. Faced with a sudden shortage of electric power from out-of-state, State regulators and utilities pressed high emitting California "peaking" units into baseline service. The sudden demand for RECLAIM allowances could not be met, and the SCAQMD has been forced to allow emissions that are in violation of the rules of the RECLAIM market.

Under the circumstances, SCAQMD's choices were: (1) to issue "variances" that would legalize the emissions, but completely destroy the credibility of the RECLAIM system; (2) to allow utilities to "borrow" allowances against future supply; or (3) to "print money," legalizing the excess emissions in return for utility contributions to a fund to pay for emission reductions from other emission sources within the Los Angeles basin. SCAQMD chose the third of these options--in effect a post-hoc recognition that the initial RECLAIM market did not include a broad or diverse enough base of emission sources.

n147. Office of Water, Envtl. Prot. Agency Pub. 800-r-96-001, Draft Framework for Watershed-Base Trading 5-10 (1996). EPA has recognized the importance of the allocation decision, without recognizing that it is a problem only in "cap and trade" systems. See id.

n148. In an auction scheme, all emission rights must be purchased by potential users. Emission tax schemes do not provide for any allocation of rights, since they simply impose a tax on whatever the source emits. It is, of course, possible to imagine an emission tax scheme with exemptions for a certain amount of emissions. In effect, such a system would be allocating emission rights also.

n149. See CAA 403(f).

n150. See id. 404-405 (the formula for the allocation of acid rain allowances). The Ozone Transport Commission made an initial allocation by state. Each state must then develop its own formula for allocating to sources within the state.

n151. See Ayres, supra note 10.

n152. See *63 Fed. Reg. 56,356* (proposed Oct. 21, 1998). The Generation Performance Standard was proposed by Public Service Electric & Gas of New Jersey and the Natural Resources Defense Council.

n153. See id.

n154. See id.

n155. See id.

n156. See id.

n157. See id.

n158. See NESCAUM/MARAMA, supra note 53.

n159. See id.

n160. See id.

n161. See WMB-2, supra note 101.

n162. See Anderson et al., supra note 26, at 6-1.

n163. See Burtraw, supra note 5, at 1.

n164. See 40 C.F.R. pt. 75.

n165. See id.

n166. See Ayres, supra note 10.

n167. See id.

n168. See id.

n169. *64 Fed. Reg. 26004, 26057* (proposed May 13, 1999).

n170. See generally 40 C.F.R. pt. 94; 40 C.F.R. pt. 9 86, 89; 40 C.F.R. pt. 89. The EPA is currently moving to regulate off-road engines, which would otherwise be included in this list. EPA regulations for small, handheld engines such as those used on "weed whackers" and chainsaws become effective in 2005-7.

n171. See generally Vehicle Emission Study, supra note 17. Any attempt to regulate emissions of carbon dioxide faces the same issues. Since atmospheric loadings of CO<2> can be achieved by fuel switching, changes in energy sources or cycles, and increasing the capacity of "sinks," such as forests, with widely varying cost-effectiveness, the potential arbitrage is staggering.

n172. See generally id. See also Norman Senjem, Water Quality Discussion, Minn. Pollution Control (1997).

n173. See generally Vehicle Emission Study, supra note 17.

n174. See generally Ayres, supra note 10. While the current command and control system on paper requires zero errors in measuring emissions, in reality it accepts large inaccuracy and bias because official tests of emissions discharges are so rare.

n175. See NESCAUM/MARAMA, supra note 53.

n176. See id.

n177. See id.; see also Suzi Kerr et al., Center for Clean Air Policy, Policy Options for Addressing Compliance Issues Raised by Emissions Trading (Nov. 1998).

n178. See World Bank, Global Climate Change Division (1999). The World Bank recently created a Prototype Carbon Fund, designed to facilitate carbon trading under an international global warming regime. Funded by several European countries and corporations, its objective is to obtain "high quality emission reductions" that can later be used to comply with international carbon reduction requirements.

n179. See Burtraw, supra note 5.

n180. See Ayres, supra note 10.