# Best Practices Guide: Market Approaches to Environmental Protection

Prepared for:
Energy and Environment Training Program
Office of Energy, Environment and Technology
Global Bureau, Center for Environment
United States Agency for International Development

Implemented by:

The Energy Group
Institute of International Education
Washington, DC

Prepared by:

Energy Resources International, Inc.
Washington, DC

ERI

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# Contents

## Acronyms

| | |
|---|---|
| AAR | Authorized Account Representative |
| AIJ | Activities Implemented Jointly |
| ATS | Allowance Tracking System |
| BACT | Best Available Control Technology |
| CA | California |
| CAA | Clean Air Act |
| CAC | Command and Control |
| CDM | Clean Development Mechanism |
| CEMs | Continuous Emissions Monitors |
| CEUs | Certified Emissions Units |
| CIF | Carbon Investment Fund |
| CO2 | Carbon Dioxide |
| DFI | Direct Foreign Investment |
| DSM | Demand Side Management |
| EE | Energy Efficiency |
| EPA | Environmental Protection Agency |
| ERI | Energy Resources International |
| ERU | Emission Reduction Unit |
| ESMAP | Energy Sector Management Assistance Program |
| ETS | Emissions Tracking System |
| FCCC | Framework Convention on Climate Change |
| GHG | Greenhouse Gas |
| ICCPF | International Climate Change Project Fund |
| IIE | Institute of International Education |
| IUEP | International Utility Efficiency Partnerships |
| JI | Joint Implementation |
| MAC | Marginal Abatement Cost |
| MACT | Maximum Available Control Technology |
| MC | Marginal Cost |
| MT | Million Tons |
| MW | Megawatt |
| NAAQS | National Ambient Air Quality Standards |
| NATS | $NO_x$ Allowance Tracking System |
| NETS | $NO_x$ Emissions Tracking System |
| $NO_x$ | Nitrogen Oxide |
| OTAG | Ozone Transport Assessment Group |
| OTC | Ozone Transport Commission |
| PFC | Progressive Flow Control |
| PUC | Public Utility Commission |
| RACT | Reasonably Available Control Technology |
| RECLAIM | Regional Clean Air Incentives Market |
| SCR | Selective Catalytic Reduction |
| SIP | State Implementation Plan |
| SNCR | Selective Non-Catalytic Reduction |
| $SO_2$ | Sulfur Dioxide |
| USAID | United States Agency for International Development |
| USIJI | U.S. Initiative for Joint Implementation |
| VOCs | Volatile Organic Compounds |
| WTP | Willingness to Pay |

## Acknowledgments

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The material found in this Guide was adapted from a three-week course developed and presented by Energy Resources International, Inc. (ERI) to a multinational audience in Washington, DC. EET would like to acknowledge the expertise and commitment of the principal authors of this Guide— David South, Vice President, and Robyn Camp, Consultant, Technology & Markets Group, ERI. These individuals' commitment to providing the highest quality training materials has allowed this Guide to be of equally high quality. EET would also like to thank the Institute of International Education (IIE) for their support in bringing this Guide to completion, as well as their commitment to implementing and administering quality training programs.

ERI would also like to thank the following individuals who served as course instructors. This report is drawn from information presented by each of them. Instructors included:

| | |
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## Introduction

The United States Agency for International Development's (USAID) Global Center for Environment has developed the Best Practices Guide Series to provide technical information on the topics of energy efficiency and the environment to support international initiatives and promote the use of clean and innovative technologies. This series of guides is adapted from coursework that was designed to develop technical leadership capacity in energy development and greenhouse gas (GHG) emissions reduction that are both friendly to the environment and beneficial to economic growth.

This guide is for policymakers, project developers and others involved in the development of policy and regulatory tools for emissions reductions projects. It provides the contextual understanding necessary to design and develop an emissions trading program. Through a contract with the Energy Group at the Institute of International Education (IIE), USAID's contractor for the Technical Leadership Training Program, Energy Resources International (ERI) has prepared the *Best Practices Guide: Market Approaches to Environmental Protection*.

IIE's Energy Group provides assistance and training to government and business leaders to develop the skills and knowledge they will need to succeed in meeting their energy management and national development goals.

ERI is a technical and economic consulting firm serving clients in the energy and environmental industries. ERI specializes in resource, technology and market analyses, economic and environmental consulting, and strategic energy planning and procurement.

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# Chapter 1

# Economics of Environmental Control

While environmental regulations are the primary means used by governments to induce protection of the environment (air, water, land), the policies and instruments to implement regulations have changed over time. The current emphasis is on market-based instruments rather than command-and-control (CAC), due to their compliance flexibility and cost-effectiveness.

Environmental regulations are necessary since the environment is a "public good" that has not traditionally been included by firms in their cost of producing goods and services. As such, it is external to the cost of production (i.e., "externality"), and any damage to the environment (or consumption of its services) is then borne by society. The objective of environmental regulations is to implement the "polluter pays principle" and have firms "internalize" this cost of production.

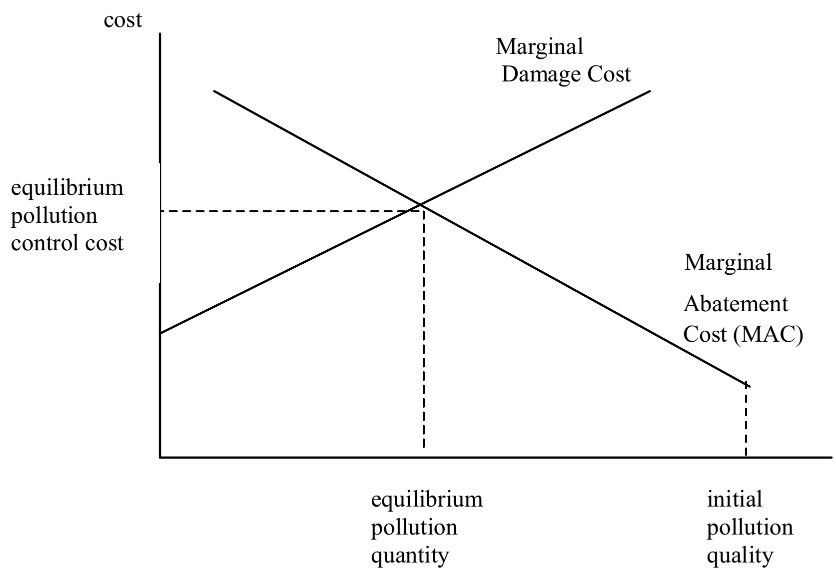
In specifying the environmental regulation, the objective is economic efficiency. That is, the regulation should seek to maximize net benefits—avoided damages should be greater than the cost of environmental protection and improvement. This is accomplished by equating the marginal cost of the environmental damage with the marginal cost of protection (See Figure 1.1).

There is a range of policy options available to implement environmental regulations. These include:

- *Voluntary Standards*—recommended environmental guidelines or standards, but without compliance enforcement. Participants may receive benefits for adhering to the standards, but are not penalized for not doing so. Such standards typically have a limited effect.
- *Command and Control Standards*—legal requirements to reduce emissions to specified levels. These standards often require the use of a specified technology to control emissions, and may be site-specific.
- *Economic Incentives*—including
  - *Emissions Taxes:* assess a fee (tax) for each unit of emissions. All emitters should control until the marginal abatement cost (MAC) = tax (See Figure 1.2), so there is a cost-effective distribution of effort and all emitters seek the least-cost method to reduce total compliance costs.
  - *Tradable Emissions Quotas:* establishes a cap on allowable emissions and permits sources to buy/sell the right to emit from other sources. In a permit market, all emitters buy/sell permits (depending on initial endowment) until MAC = permit price (See Figure 1.3). Emissions not covered by permits are abated at least cost—emitters will search for lowest cost abatement method to reduce abatement expenses and permit costs.

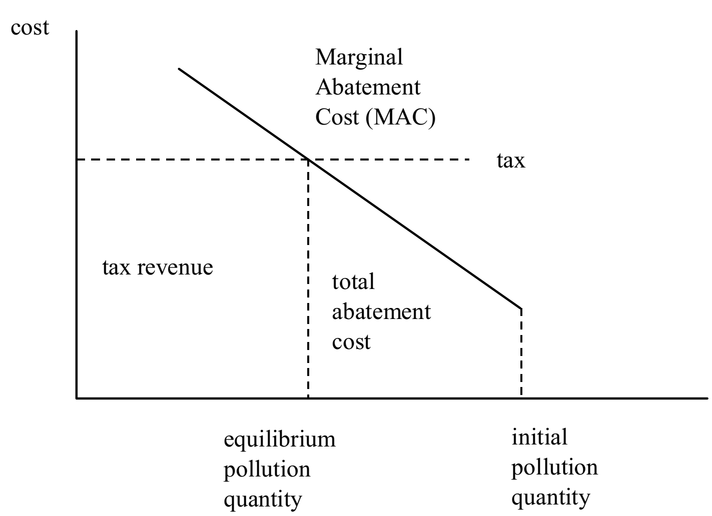
- *Deposit-Refund Program*—requires participants to pay a deposit before using a resource but refunds their deposit when the resource is returned.

**Figure 1.1 Economics of Environmental Control**



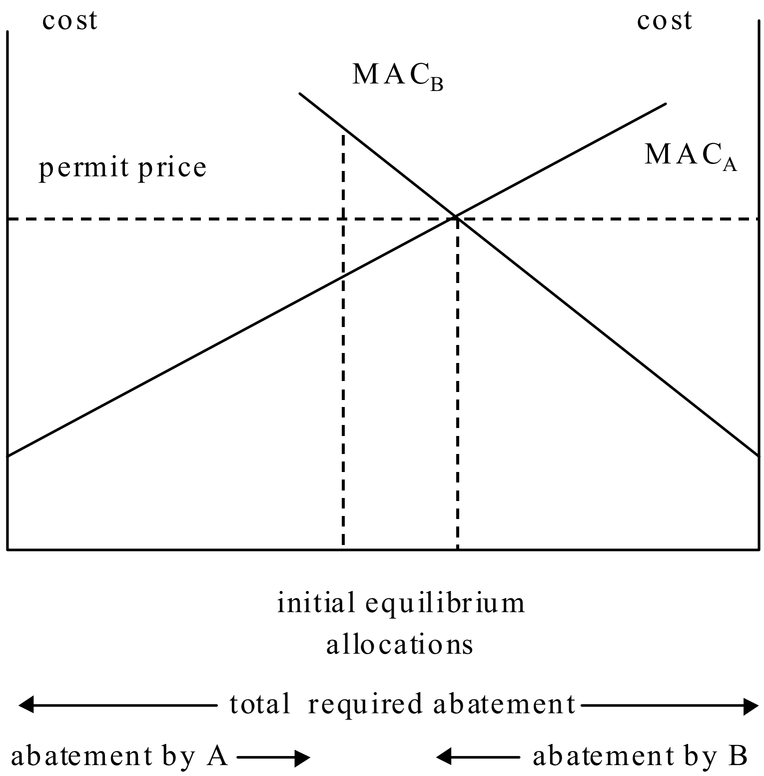

Source: Michael Toman, *Designing Environmental Policies: Basic Concepts*, presented at Market Approaches to Environmental Protection Workshop, May 15-June 2, 2000, Washington D.C.

**Figure 1.2 Economics of Emission Taxes**




Source: Michael Toman, *Designing Environmental Policies: Basic Concepts*, presented at Market Approaches to Environmental Protection Workshop, May 15-June 2, 2000, Washington D.C.

**Figure 1.3 Economics of Tradable Emission Permits/Quotas**




Source: Michael Toman, *Designing Environmental Policies: Basic Concepts*, presented at Market Approaches to Environmental Protection Workshop, May 15-June 2, 2000, Washington D.C.

Each policy option requires different underlying market conditions to be effective. While each option may achieve the same environmental goal, each may have different impacts (costs/benefits) and induce different behavior by the participants. For example, taxes will limit the size of the MAC, but does not necessarily assure achievement of quantitative emission standards. Alternatively, permits can satisfy quantitative emission standards, but could result in upward pressure on the permit price (MAC). The tradeoff between taxes and permits depend on the nature of environmental risks:

- If environmental damage costs are fairly uniform, then a tax-based approach has minimal risk of compromising the environment, but limits the risk of unacceptable compliance costs.
- If environmental damage costs show strong threshold effects, then a limit on the quantity of emissions (via permits) is better.

Choosing the appropriate environmental policy requires a balancing of economic, environmental and political goals.

Incentive-based policies have the best prospect for success in a well-functioning market economy, where individual firms have the incentive to minimize their own costs. Incentive policies, however, are less effective in command economies. One reason is that incentive policies depend on well-established legal property rights, which do not typically exist in command economies. Another is that environmental policies operate on top of existing market organizations and pricing regimes. Distorted markets (via subsidies or monopolies) encourage both environmental and economic waste, hampering cost-effective environmental improvements.[1] All environmental policies depend on a viable legal system for enforcement.

[1] A monopoly will keep product prices lower, requiring a tradeoff between economic and environmental goals. In contrast, subsidies, trade and investment restrictions, distort the economic signals on which regulated entities make their decisions. Economic regulation or government control of business compromises the cost-effectiveness of incentives by blunting or distorting cost minimization incentives.

# Chapter 2

# Economic Instruments to Reduce Emissions

In the United States, the approach to pollution control has evolved over several decades. Public awareness of environmental issues began in the 1960s. Increasing concern about the need for pollution abatement led to passage of the 1970 Clean Air Act (CAA)—the first significant piece of federal legislation to establish regulations and policies in support of clean air. Twenty–years later (1990), the CAA was amended to include the use of economic instruments to achieve environmental compliance.

Initially, the Clean Air Act was a relatively straightforward law. Using a "command-and-control" approach, it required the use of best available control technologies (BACT) for any new emission sources built after its passage, and required pollution controls on existing emission sources as needed to protect public health and welfare. Through amendments to the CAA, some compliance flexibility was introduced through variances negotiated with individual companies or regional areas (counties). For example, environmental regulators and private companies worked together to develop new economic instruments such as "offsets". Offsets allowed an existing source to reduce its emissions beyond that required—when it was cost-effective—in order to permit emissions at a new source, so long as total emissions in the air shed were not increased.

Over the years, clean air legislation grew more complex—partly in response to a failure to achieve all the goals of the CAA, and partly in light of improved science that increased understanding of air pollution effects and the ability to achieve more stringent environmental targets. All parties (regulators and affected industries) began to search for workable solutions that would achieve better environmental protection at a lower economic cost.

In 1990, the Clean Air Act was amended in a series of titles that introduced highly prescriptive requirements (without altering the basic structure of the 1970 CAA), but also increased the potential for market-based incentives to provide compliance flexibility. Written into the 1990 Amendments were market-based mechanisms such as marketable permits, emission fees, and deposit-refund programs.

Through the use of taxes or fees, or implementing a trading system, market-based instruments allow *either* the price or the quantity to be determined by market participants**.** Market-based mechanisms allow market participants the flexibility to choose a compliance strategy that will maximize profit for their unique circumstances. The market then determines the price of different control options. While political or societal factors may affect the use of market-based instruments, such programs can achieve significant emission reductions at a relatively low-cost.

Although initial response to reliance on economic instruments was mixed, the market quickly learned how to use such instruments effectively. Now, market-based mechanisms are an integral part of most new (and proposed) environmental regulatory programs in the United States.

### *Command and Control*

Command and control (CAC) standards are binding requirements specified in laws or regulations. The government directly or indirectly specifies a technology to be used to meet a reduction target—either reasonably available control technology (RACT), best available control technology (BACT) or maximum available control technology (MACT). Polluters are then responsible for future installation of the specified technology and to report required operating data to the government, which monitors compliance.

For some pollutants, CAC regimes may be the only viable regulatory alternative. In some cases, only one control option may exist. Because CAC schemes are relatively easy to administer and enforce, they may be an important option for countries that do not have resources to administer environmental programs and/or do not have property rights laws.

Alternatively, the front-end work required to define the most appropriate control requirements and technologies may be more extensive than for other mechanisms. In addition, CAC regulations are accompanied by significant information and monitoring requirements. Because CAC regulations provide minimal flexibility for polluters to innovate, they are often very costly in terms of compliance. CAC control costs vary by affected source depending on their location, size, configuration, utilization rate, etc. Since CAC regulations require that all sources comply with particular requirements using the same technology, they lack flexibility to take advantage of differential control efficiencies at various sources, resulting in economic inefficiency and higher cost solutions.

In response to these issues, CAC standards have evolved to allow different levels of flexibility:

- *Uniform Rollback*—a target emission requirement is adopted for all affected sources. While simple to implement, with relatively low administrative costs, there are several economic problems that exist. First, there is no incentive for firms to "over control", even if it is cost-effective to do so. Second, it is not necessarily a cost-effective option, since there may be social costs due to the misallocation of resources. And, third, there is an implicit incentive to cheat, since each firm is required to self-certify its compliance.
- *Least-Cost Rollback*—in this option, emission reductions are allocated to each affected source. Consequently, this option requires the pollution control authority to gather information on each source and then allocate emissions requirements. Since source-specific conditions are considered, least-cost rollback can be a more cost-effective option than a uniform rollback. However, administrative costs are high and there can be an arbitrary

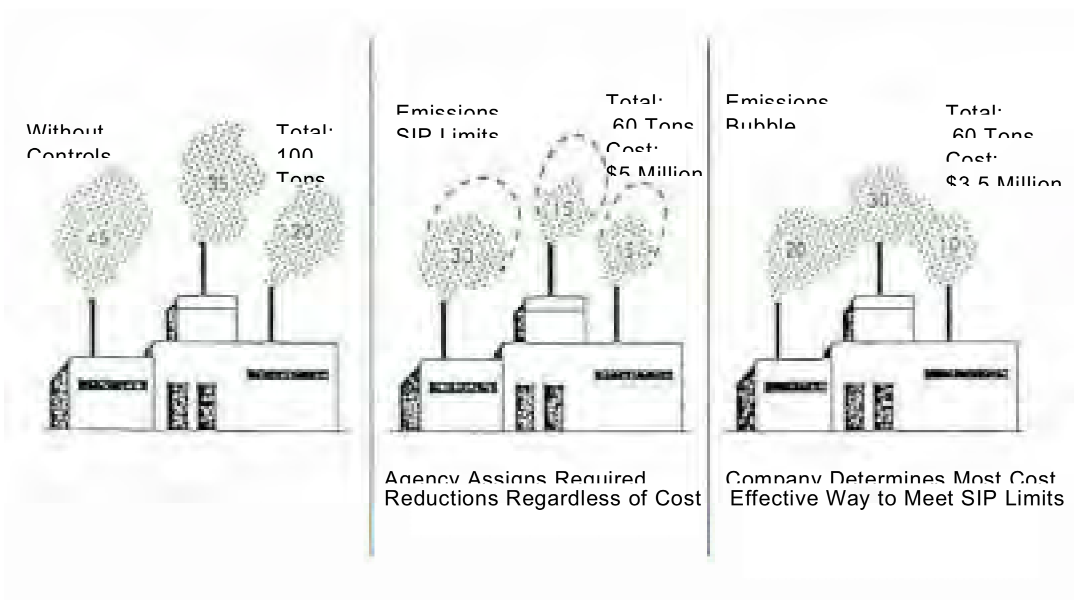
allocation of emission reductions; it could limit the flexibility of affected sources to determine the best compliance option, and a negative incentive exists with respect to turnover of aging capital stock.

- *Least-Emissions Dispatching*—is a form of least-cost rollback. It achieves rollback targets by, for example, modifying the dispatch routine of electric utilities to include the operating and environmental compliance costs at each plant. As such, least-emissions dispatching improves the cost-effectiveness of compliance, especially when combined with emissions taxes, fees or trading programs. While cost-effective, it is only a short-term solution and does not address the issue of new emission sources or the growth in emissions with increased generation.

### *Emission Bubble and Offsets*

Command and control regulations regulate emission sources that are easy to identify and control, and are prescriptive. To counteract these deficiencies the "bubble concept" was developed. As illustrated in Figure 2.1 it permits: 1) emissions from more than one source to contribute to achieving the required emissions reduction more cost-effectively, and 2) sources under the bubble to trade emission allowances.

**Figure 2.1 U.S. EPA Bubble Policy for Existing Sources**



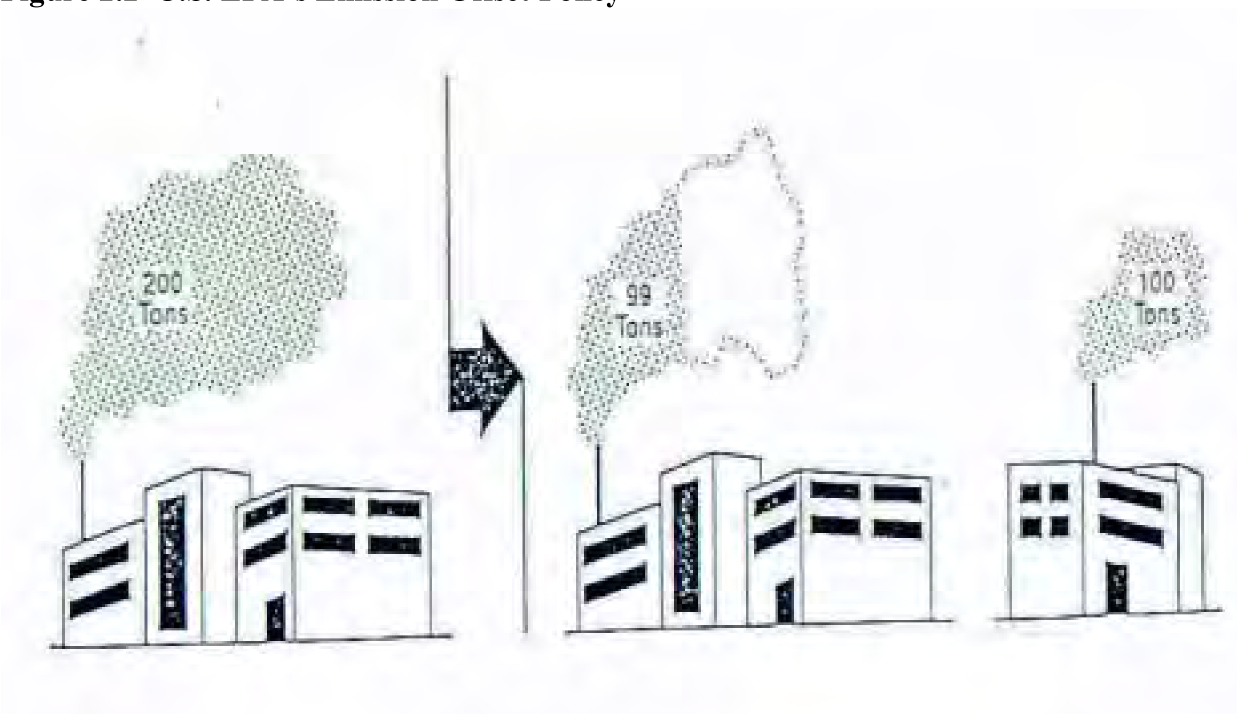

Source: Adapted from U.S. EPA.

Another form of a bubble is an offset. An offset allows an existing pollution source to reduce its emissions by an amount that permits a new source to be introduced in the air shed without any increase in emissions (see Figure 2.2). Emissions offsets can improve the overall cost-effectiveness of regulations.

### *Emissions Taxes/Fees*

Taxes or fees require affected emission sources to pay an amount equal to the environmental cost of emission. The *level* of emissions is then determined by the "willingness-to-pay" for the right to emit by the affected sources. As depicted in Figure 1.2, all emitters would reduce emissions to the level where the marginal abatement cost (MAC) is equal to the tax. In this way, all sources seek the least-cost method to reduce total compliance expenditures. However, while taxes/fees limit the size of the MAC, they do not necessarily assure achievement of the quantitative emission standards. In addition, taxes shift significant revenue to the government, making private compliance costs higher than CAC (though social costs may be lower). The increased government revenue can be used to offset other more distorting taxes in the economy, limiting the overall cost of environmental protection.

**Figure 2.2 U.S. EPA's Emission Offset Policy**




Source: Adapted from U.S. EPA.

### Emissions Trading Schemes

Emissions trading is the instrument used in *cap and trade* programs. Emissions are capped at a level that ensures environmental integrity and are quantified in tons. The difference between a bubble/offset and emissions trading is that the former exchanges emission credits (or emission reductions), while with emissions trading the exchange is for permits (allowances) or the "right-to-emit".

In all trading programs, sources are required to monitor and report their emissions. In an annual reconciliation, sources must hold a credit or an allowance for each ton of pollution emitted.

Excess credits/allowances resulting from the reconciliation may be registered in a bank and reserved for future use.

In a *credit* trading program, sources may earn the right-to-emit by either reducing their emissions to levels below the standard, or by reducing emissions prior to the mandated deadline. Any reduction beyond what is required can be traded with other sources. In an *allowance* trading program, sources are allocated emission rights, which they can either use themselves or trade with other sources. Since the number of allowances is finite, the price of each allowance will be determined by supply and demand. Because the number of allowances is fixed, these programs are easier to administer than credit trading programs.

As depicted in Figure 1.3, in emissions trading, emitters buy or sell allowances (depending on their initial endowment) until the MAC equals the permit price. Emissions not covered by the allocated permits are abated at the least cost. Therefore, emissions trading will limit the total quantity of pollution emitted but might result in a higher permit price (due to permit bidding and the slope of the MAC). This permit price is determined by the market, and can be included by industry in any profit/loss calculation pertaining to its compliance decision. Any distributional issues with permits can be addressed through the initial permit endowment (allocation) process without affecting the efficiency of the trading system.

For an emissions trading program to operate effectively the following must exist:

- *Property Rights*—a tradable commodity must be created which represents the right-to-emit. The permit must have unlimited duration in order to provide the long-term certainty needed to induce firms to invest in control technologies and create secondary markets in which to compare the cost of control versus trading.

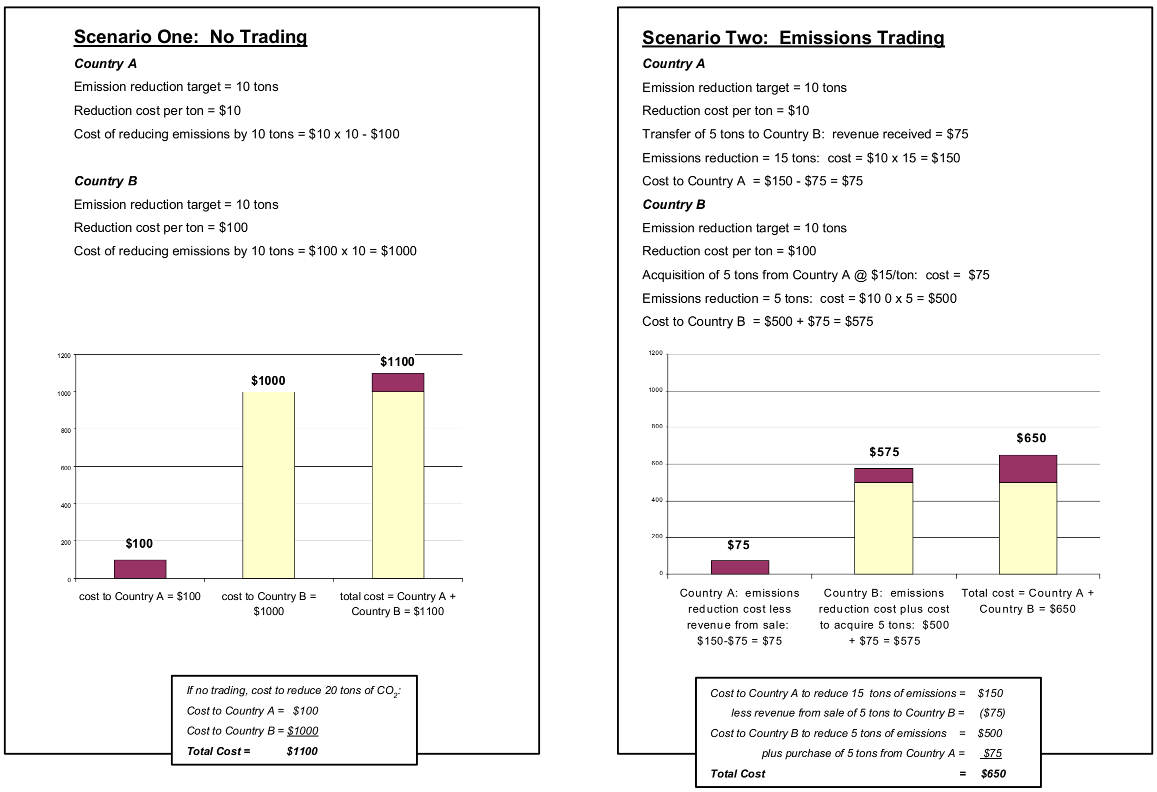
- *Allowance Market*—a market with clear price signals must exist in which to buy/sell allowances. Two different types of markets are possible: an internal market in which trading occurs within a plant or between plants owned by the same firm; or, an external market allowing trade between different firms. The success of the market depends on, for example: the number of participants, technological conditions, profit incentives, the initial distribution of trading rights and any geographical limits on trading.

- *Established Rules Governing Trading*—the efficient operation of markets needs: information to locate available emission permits, stable rules (changes introduce uncertainties and discourage participation), simplicity/clarity (with limited regulatory oversight), and enforcement of the rules.

Figure 2.3 illustrates the potential for cost savings through emissions trading. Emissions trading creates an environmental asset which can aid in financing pollution control. Early reductions through banking can be accomplished when benefits are large, and costs are low. Trading focuses enforcement resources efficiently and is highly effective in achieving the environmental goal, provided that monitoring and enforcement are adequate. It also creates incentives for new control technologies by creating competitive market opportunities. An emissions trading strategy also provides a unique avenue for cooperation in solving trans-boundary pollution problems among nations.

In emissions trading programs, sources are allowed to save emissions credits for future use in a legally protected manner. Programs are designed to encourage firms to adopt inexpensive emissions reductions strategies at early stages, creating a pool of readily available emissions credits/permits that can be used in conjunction with plant modernization/expansion. Trading also provides an effective means for firms to match emissions credits/permits to the needs of the marketplace or changes in product demand.

**Figure 2.3 Cost of Compliance With and Without Emissions Trading**




### *Summary*

Deciding which policy instrument to use depends on the nature of the environmental risk. If the priority is controlling environmental quality at all costs, then a command-and-control system may be preferred. However, if the priority is minimizing risk (and if costs of environmental damage are fairly uniform), a tax or trading program will limit the risk of unacceptable compliance costs, and with a low risk of compromising the environment. For this reason, emissions trading programs have been increasingly put into practice in the United States at national, regional and local levels, and have been determined to be an environmental and economic success. Table 2.1 lists several of the more developed initiatives; other programs are tabulated in Appendix A. National and regional emission trading initiatives are further discussed in Chapters 3 and 4.

**Table 2.1 Emissions Trading Programs in the United States**

| | National | Regional | State | Local |
|---|---|---|---|---|
| $SO_2$ | U.S. EPA Sulfur Allowance Trading System | | | |
| $NO_x$ | U.S. EPA $NO_x$ SIP Call Model Rule (proposed) | Ozone Transport Commission | California<br>Colorado<br>Connecticut<br>Delaware<br>Louisiana<br>Maine<br>Massachusetts<br>Texas | CA Air Quality Management Districts: South Coast, San Diego, Sacramento |

# Chapter 3

# The Acid Rain Program

Amendments to the U.S. Clean Air Act were passed in 1990, which included provisions to establish an acid rain trading program (Title IV). The goal of the program was to reduce national $SO_2$ levels by 10 million tons (MT), from approximately 18 million tons in 1980. The bulk of this reduction (8.5 MT) was to come from power industry participation in a *cap and trade* program, with the remaining (1.5 MT) reduction accomplished through other policies and measures. The total level of $SO_2$ emissions reduction was determined by the U.S. Environmental Protection Agency (EPA) based on desired environmental improvements and with consideration of expected costs. It was estimated that the 10 MT reduction would cost approximately $10 billion per year. The acid rain program also called for a 2 MT reduction in $NO_x$ emissions, using traditional CAC standards, accomplished in two steps.

The $SO_2$ cap and trade program was an entirely new pollution control program. It set goals and control requirements in terms of *allowable* emissions (not emissions reductions). Reduced and capped emissions were designed to ensure attainment and maintenance of the emissions goal. Finally, it required measurement and reporting of all emissions.

The $SO_2$ program was implemented in two phases. During Phase 1, beginning in 1995, the country's 110 largest and dirtiest power plants were required to reduce their emissions by an amount based on their historic generation over a three-year period.[2] When the allocations were made, each affected unit received—free of charge—one allowance for each ton of $SO_2$ it was authorized to emit annually during each year of the program. During Phase 2, beginning in 2000, all plants larger than 25 MW (a total of 425 plants) are required to participate and receive allocations based on each unit's historical profile multiplied by a lower emissions standard than in Phase 1.[3] This lower emission rate permitted more plants to be included under the emissions cap. Moreover, as indicated in Figure 3.1, the average emissions rate would continue to decline as more generation is needed under a fixed emissions cap.

To encourage efficiency and the use of clean technologies, EPA gave "clean" plants allocations based on 120% of their generation. Because new sources received no allocation, and in response to concerns that existing generators would shut out new generators, EPA reserved a portion of the allowances (275,000) to be auctioned each March at a price of $1500/ton.

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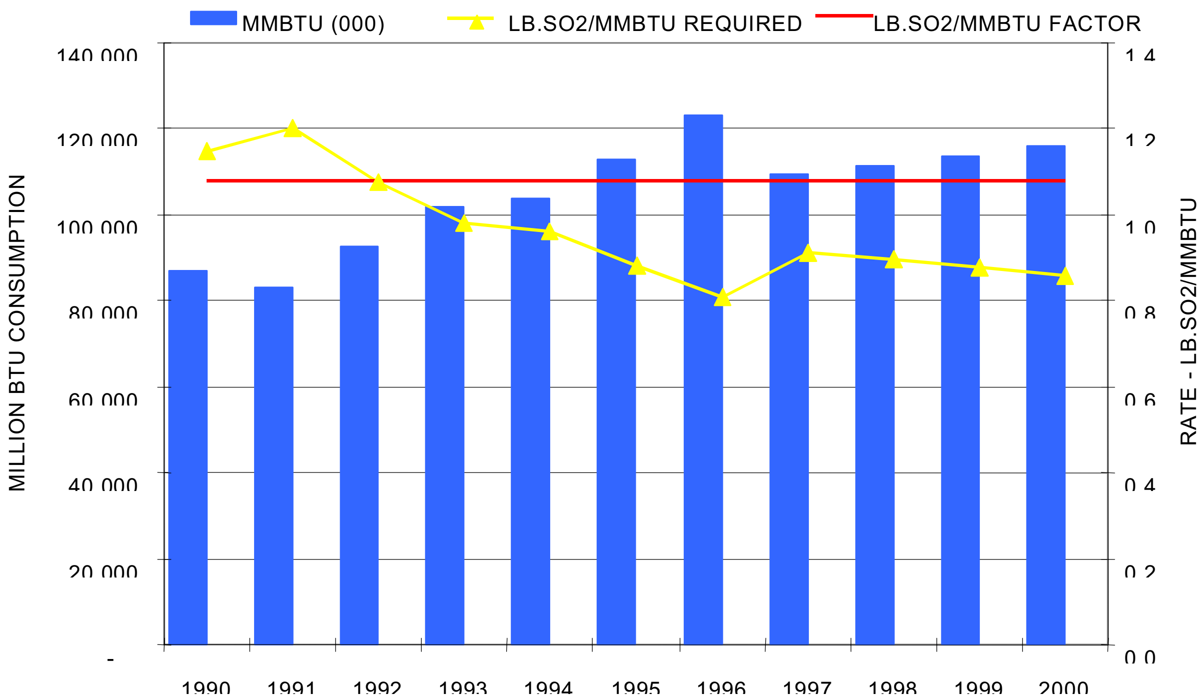
[2] 2.5 lb. $SO_2$/MMBtu multiplied by the unit's average Btu consumption for the years 1985-1987.

[3] 1.2 lb. $SO_2$/MMBtu multiplied by the unit's average Btu consumption for the years 1985-1987.

**Figure 3.1 $SO_2$ Allowance Trading Illustration**




Each source develops a $SO_2$ compliance strategy based on its marginal control cost and assigned emission allocation. Control options implemented in Phase I of the program included fuel switching, installing $SO_2$ flue gas desulfurization units (aka: scrubbers), increased operating efficiency, energy conservation, environmental dispatch (including increased generation by non-emitting generation sources), reliance on renewables, and/or allowances trading.

All allowances were fully tradable and/or bankable. Utilities could either hold their allowances (for future use) or trade them to other sources at whatever price could be negotiated bilaterally or in the market; EPA originally estimated this price would be ~$700/ton of $SO_2$. Those who have participated in the $SO_2$ cap and trade program include: electric utilities and independent power producers, merchant plant developers, energy marketers/traders, coal suppliers, industrial facilities, and small diesel refiners.

In addition to the compliance strategy, sources were required to install continuous emissions monitors (CEMs) and to compile hourly emissions data for $SO_2$, $NO_x$ and $CO_2$; these data are reported to EPA on a quarterly basis. The monitors are required to be calibrated at least once a year. Should the monitor malfunction, EPA allows the source to provide an average emissions rate— e.g., the average of the hour before the malfunction and the hour after the malfunction. However, if the malfunction is for more than a few hours, sources must use their highest emissions reported over the previous year.

To facilitate data reporting, EPA developed two web-based tracking systems: an Emissions Tracking System (ETS) and an Allowance Tracking System (ATS). The ETS records the hourly emissions data that EPA processes, assesses for quality assurance, and provides feedback to the emitting source. The data are made publicly available via the EPA website and in an annual compliance report.

The ATS records the status of every allowance transaction. Each allowance has a distinct serial number so it can easily be identified. When parties agree to a trade, each party's designed Authorized Account Representative (AAR) notifies EPA of the transaction, thereby authorizing EPA to move allowances from one account to another. EPA deducts allowances from a sellers' account and credits a purchasers' account. The transfer process usually takes place within one business day. On completion, confirmation of the trade is sent to each party and the transaction is posted on the ATS website (http://www.epa.gov/acidrain).

The compliance period ends December 31, and parties then have a 60-day grace (reconciliation) period during which they can complete their final trades. EPA suspends trading during the "true-up" or reconciliation period when it compares allowances (in the ATS) with actual emissions (in the ETS) to determine compliance. Any sources not in compliance at that time are assessed a penalty of $2000/ton (1990$)[4]—an amount EPA estimated would be approximately three times the market price of a ton of $SO_2$—and the shortfall of tons is deducted from the next year's allocation. Any allowances unused at reconciliation are carried forward to the next year's compliance subaccount. Only at the end of the reconciliation period does EPA monitor allowance balances.

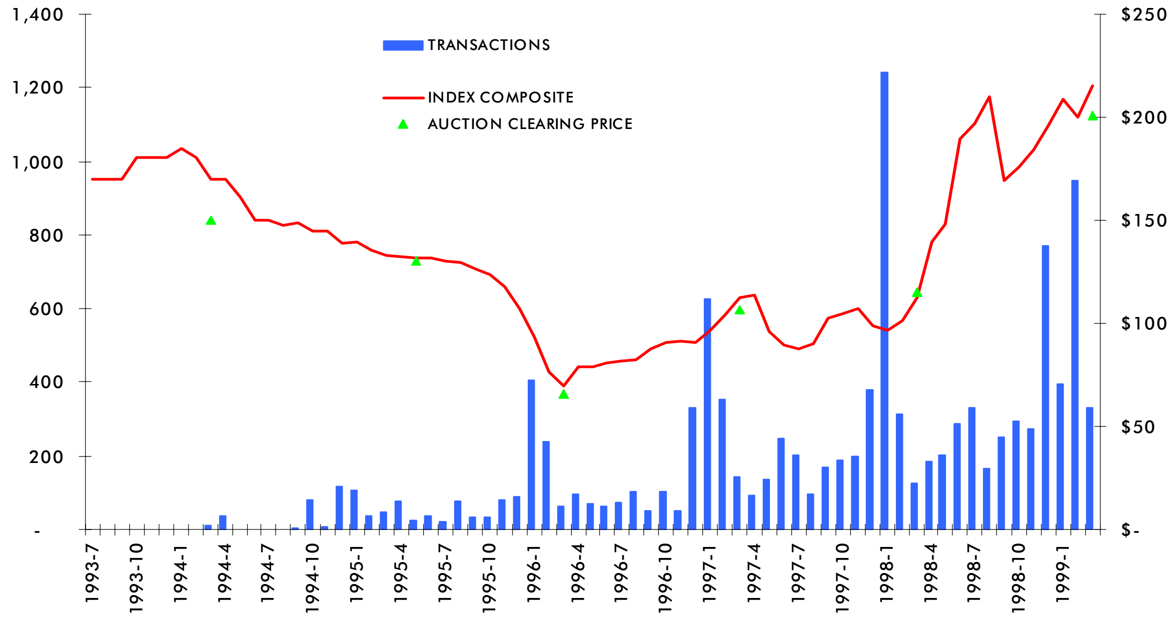
Since the $SO_2$ market opened in April 1994, EPA records indicate 31 million allowances have been traded. Trades are usually made in 2,500 allowance lots, and options in 10,000 lots. Figure 3.2 depicts the number of trades and spot prices for $SO_2$ from its start in 1993 through early 1999. As evident, most trading activity occurs during the reconciliation period in the first quarter of the year.

EPA originally estimated that the cost of compliance would increase electricity costs by 3-4% per year, but actual cost increases have been on the order of 1%—a significant cost savings. The price of a ton of $SO_2$ has reached a high of $250/ton, but has averaged approximately $100-150/ton. Current $SO_2$ prices, although rising, still remain significantly below EPA's initial estimates of $700/ton. To date, all trading and compliance targets have matched, every participant has been in compliance, and sources have made reductions beyond what was required.

EPA has also found that the program requires minimal administration. Although government plays many roles — it issues allowances, conducts annual auctions, collects, verifies and publishes all of the emissions data and allowance transfers, performs annual reconciliation, and enforces penalties for non-compliance—it takes approximately 1% of EPA's personnel (150 employees out of a total of 15,000) to run the acid rain program. Even so, this program results in approximately 40% of the entire reductions required under the Clean Air Act.

[4] In current dollars the penalty is equal to $2,682/ton.

**Figure 3.2 $SO_2$ Allowance Market Trends: Spot Prices and Number of Transactions**



# Chapter 4

# $NO_x$ Trading Programs

Nitrogen oxide ($NO_x$) emissions have been found to contribute to a number of air emission problems including ozone (smog), acid rain, fine particulates, and regional haze. $NO_x$ emissions are both an annual and a seasonal problem.

Under Title I of the 1990 Clean Air Act Amendments, the federal government delegated to states the authority to attain National Ambient Air Quality Standards (NAAQS) for ozone. States with areas that do not comply with the ozone NAAQS—known as nonattainment areas—and are classified as "moderate" or "severe", must file annual State Implementation Plans (SIPs) that gradually reduce emissions to the standard. These same states must adopt reasonably available control technologies (RACT), and require new sources (or existing sources that want to expand capacity) to offset any increased emissions by ratios defined in the CAA.

There are several forms of $NO_x$ trading:

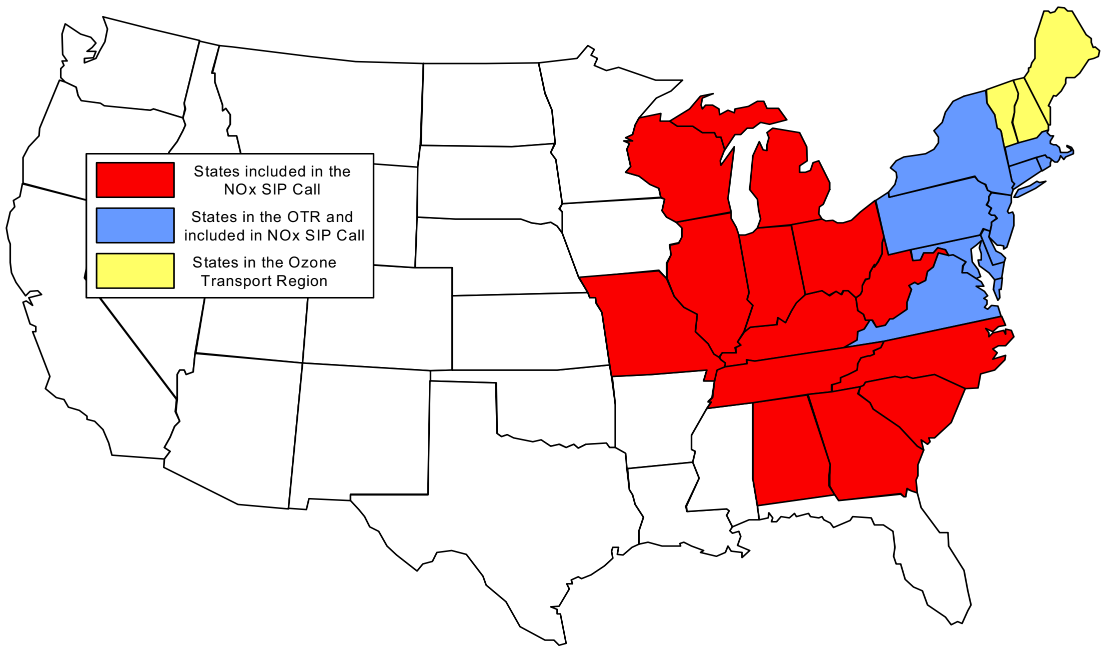
- *RACT/System Averaging*—permits trading among facilities under the *same* ownership to implement RACT (i.e., bubbling).
- *RACT/Emissions Trading*—permits trading among sources with *different* owners
- *Offset Central Registry*—identifies emissions reductions from sources needed by new/expanding sources.
- *Emissions Trading/Open Market*—establishes a baseline emissions level with scheduled reductions and tradable commodities (e.g., emission reduction credits) created when reductions exceed scheduled levels.
- *Emissions Trading/Cap & Trade*—establishes a cap on emissions with scheduled reductions and tradable allowances allocated by the regulatory authority.

### *Ozone Transport Commission (OTC)*

In the United States, 13 (of 50) states have recognized $NO_x$ compliance as a regional problem, and have implemented a regional $NO_x$ trading program during the 5-month summer ozone season (May thru September). In 1994 these 13 states signed a memorandum of understanding (MOU) creating the Ozone Transport Commission (OTC) and agreed to a two-phase seasonal $NO_x$ reduction beyond RACT (see Figure 4.1). This program is a unique partnership between the federal EPA and the states.

Each state within the OTC designs and implements its own trading program consistent with state conditions and needs. But, all participating states have agreed to adopt consistent guidelines for applicability, duration of the control period, targeted $NO_x$ emissions limitations, emissions monitoring and record-keeping and electronic reporting. In addition, each state has enacted its own

**Figure 4.1 OTC and $NO_x$ SIP Call States**




regulations, identified sources and distributed allowances, ensured compliance and monitoring, and defined awards for early opt-in sources. States work with the federal EPA, which reviewed and approved the SIPs to ensure attainment of the ozone NAAQS. EPA developed and operates the $NO_x$ allowance and emissions tracking systems (NATS and NETS), that began operation in 1998. States have the authority to establish individual enforcement procedures and penalties.

In the $NO_x$ trading model rule—using 1990 as a baseline year—emission reductions were determined on a unit-by-unit basis for electrical generating units greater than 15 $MW_e$ according to historic emission rates and location. Units in the inner OTC zone were allocated lower levels of emissions allowances than those in the outer zone; states in the outer zone were allocated lower levels of emissions allowances than those in a northern zone (see Table 4.1). The model rule did not define an allocation methodology to be used, but states are required to submit their methodology to EPA for review and approval. Approximately 900 sources are involved across all participating OTC states.

**Table 4.1 $NO_x$ Limits in the OTC Model Rule (lbs. $NO_x$/MMBtu)**

| | Inner Zone | Outer Zone | Northern |
|---|---|---|---|
| Phase II | 0.2 or 65% | 0.2 or 55% | RACT |
| Phase III | 0.1-0.15 or 75% | 0.1-0.15 or 75% | 0.2 or 55% |

When determining compliance strategies, sources must evaluate whether to 1) purchase allowances, 2) switch to (or co-fire with) a fuel that has a lower $NO_x$-content, 3) repower the unit with advanced clean coal technology, 4) tune-up the combustion system, and/or 5) install post-combustion controls (SNCR, SCR).

EPA has developed standard monitoring requirements that vary for each fuel, and for baseload vs. peaking units. Sources may also apply to use an alternative monitoring methodology that must be approved by EPA before it can be used. Hourly monitoring information is submitted electronically to EPA by an Authorized Account Representative (AAR) following a standard reporting format. EPA does quality assurance and gives feedback to the sources.

A $NO_x$ emissions allowance provides the right to emit one ton of $NO_x$ into the atmosphere from May 1 through September 30. Allowances are standardized, issued in vintage years and are tradable. As with the $SO_2$ trading program, any individual can open a $NO_x$ trading account with EPA. $NO_x$ emissions are issued in two Phases at no cost to affected sources. $NO_x$ market participants include electric utilities, independent power producers, waste-to-energy facilities, chemical plants, refineries and other large industrial plants (paper, steel, etc.). Participants also include control equipment vendors, various energy trading concerns and speculators.

At the end of each control season (September 30), sources have a 60-day grace period to complete final trades. Following the grace period, allowance transfers are frozen and each source must certify its compliance to EPA. Using the $NO_x$ Emissions Trading System (NETS) and the $NO_x$ Allowance Tracking System (NATS), EPA reconciles emissions and allowances.

Full banking and trading is permitted throughout most of the year. However, to ensure that seasonal ozone levels are not exceeded, EPA reserves the right to institute progressive flow control (PFC). At the end of each annual reconciliation period EPA compares projected emissions with the number of banked allowances. If banked allowances represent more than 10% of the trading budget, EPA will devalue banked allowances used during the next ozone season at a 2-for-1 ratio.

The OTC trading program began during the 1999 ozone season—May 1 to September 30, 1999. At the completion of the first year, all emission reductions began on time and emission sources achieved 99.9% compliance to reduce emissions by 242,601 tons of $NO_x$ in eight states—20% below the 1999 allocations. The second phase of compliance will begin in 2003. In 1999, allowance prices reached a high of ~$6,500/ton, but ended the year at just under $1,000/ton. The first unconditional $NO_x$ trade was at $1,700/ton, which exceeded the original estimate of $1,500/ton. More than 35,000 tons have been traded to date, usually in lots of 50-100 tons. Several energy trading and marketing firms are active in the $NO_x$ market.

In the $SO_2$ trading program, allocations are permanently awarded on the basis of performance during 1984-1987. In the $NO_x$ trading program, allocations are periodically updated to reflect changes in ozone conditions and scientific knowledge. The first five years of allocations are based on historical fuel use. At the end of that period, EPA has the option to update allocations using output (generation) data, and incorporating new units that have come online.

### *The $NO_x$ SIP Call* [5]

Since the OTC determined that their $NO_x$ reduction program would not bring the region into compliance, due to the transboundary flow of $NO_x$ across state boundaries, they asked EPA to take further actions against downwind sources. In response, EPA issued a call for State Implementation Plans ($NO_x$ SIP Call) in 1998[6] to 1) reduce seasonal $NO_x$ emissions in 22 states and the District of Columbia by 2003 (see Figure 4.1) and 2) create a Federal $NO_x$ Budget Trading Program. Under this proposal, each targeted state is required to develop and implement programs as necessary, to reduce $NO_x$ levels by 2003. EPA analyses determined that a multi-state *cap and trade* program for large stationary sources would be the most cost-effective method of implementing the $NO_x$ SIP Call. (Litigation is pending as to whether or not EPA has the authority to mandate a $NO_x$ trading program).

Similar to the OTC, the $NO_x$ SIP Call establishes minimum criteria for each state program—including a standard of performance (0.15 lbs./million Btu), requirements for measurement and reporting, and guidelines for an emissions trading program. Accompanying the SIP Call is a "model rule" for a $NO_x$ trading program that establishes a framework for the voluntary program. The framework defines guidelines for achieving environmental goals, market formation, and program administration functions for states—but permits each state to modify the framework to reflect individual state goals. For example, each state can adopt the model rule in its entirety or choose to adopt a different— but consistent— rule. The individual state rules will link together to form a multi-state trading program.

While EPA's authority to require a federal $NO_x$ trading program through the SIP Call is currently in litigation, Section 126 of the Clean Air Act gives EPA the authority to require $NO_x$ reductions. But these cannot be accomplished through a cap and trade program. Instead, EPA is required to reduce 500,000 tons of $NO_x$ from 392 facilities in 13 states. These reductions would be implemented through a federal $NO_x$ budget trading program—where states would <u>not</u> have the ability to tailor the program to their own

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[5] The $NO_x$ SIP Call was developed from research and policy guidance performed by the Ozone Transport Assessment Group (OTAG). OTAG was composed of 37 states and was convened by the U.S. EPA to investigate the assertion (by the OTC) that long-range transport of $NO_x$ was a significant obstacle to achieving ozone targets in the Northeast. OTAG concluded that transport is a regional—but not long-range trans-boundary—problem, and recommended 1) additional modeling of the transport issue, and 2) a $NO_x$ emission rate of 0.15 lbs./MMBtu or 85% reduction for utility boilers greater than 250 MMBtu/hr.

[6] EPA has this authority under Section 110 of the Clean Air Act.

[6] For example, EPA now determines applicability choices, early credit methodology and allocation methodology, which are determined by states under the $NO_x$ SIP Call.

guidelines, as available under the SIP.[7] Should the court rule against EPA implementing the $NO_x$ SIP Call, EPA instead expects to implement a federal $NO_x$ budget trading program under Section 126.

[7] For example, EPA now determines applicability choices, early credit methodology and allocation methodology, which are determined by states under the $NO_x$ SIP Call.

# Chapter 5

# Lessons Learned from U.S. Emission Trading Programs

There is considerable experience in the U.S. regarding emissions trading. In addition to $SO_2$ and $NO_x$, trading programs have also been established for other pollutants and for smaller geographic jurisdictions. Some states and local areas have instituted trading programs that either target other pollutants (e.g. hydrocarbons) and/or are more stringent than federal air pollutant standards. Appendix A contains a compilation of these programs. Lessons learned from the lead, $SO_2$ and $NO_x$ trading programs are discussed below.

### *Lead Trading*

In 1975, the U.S. EPA began a phase-down of leaded gasoline, and in 1982 added a trading component to the program. From 1985 to 1987, 400 refineries were allowed to bank or trade credits for any emissions reductions made in advance of their compliance date. This program was the first attempt to trade emissions in the U.S.

EPA expectation, based an academic analysis, was that market incentives would reduce the need for oversight and overall administrative costs. The trading scheme did help to save costs while phasing down use of lead, but EPA also found that the number of violations increased with the degree of freedom in the market.

In a review of the program, EPA identified errors in its design, such as a lack of auditing, minimal enforcement and assessment of only nominal penalties. Fraudulent trades and other violations were difficult to investigate and prosecute because permits were not numbered or tracked. Applying this experience to design of subsequent trading programs, EPA was able to factor in costs for start-up and for monitoring and verification. The agency was also cognizant of the potential for violations.

### *$SO_2$ Trading*

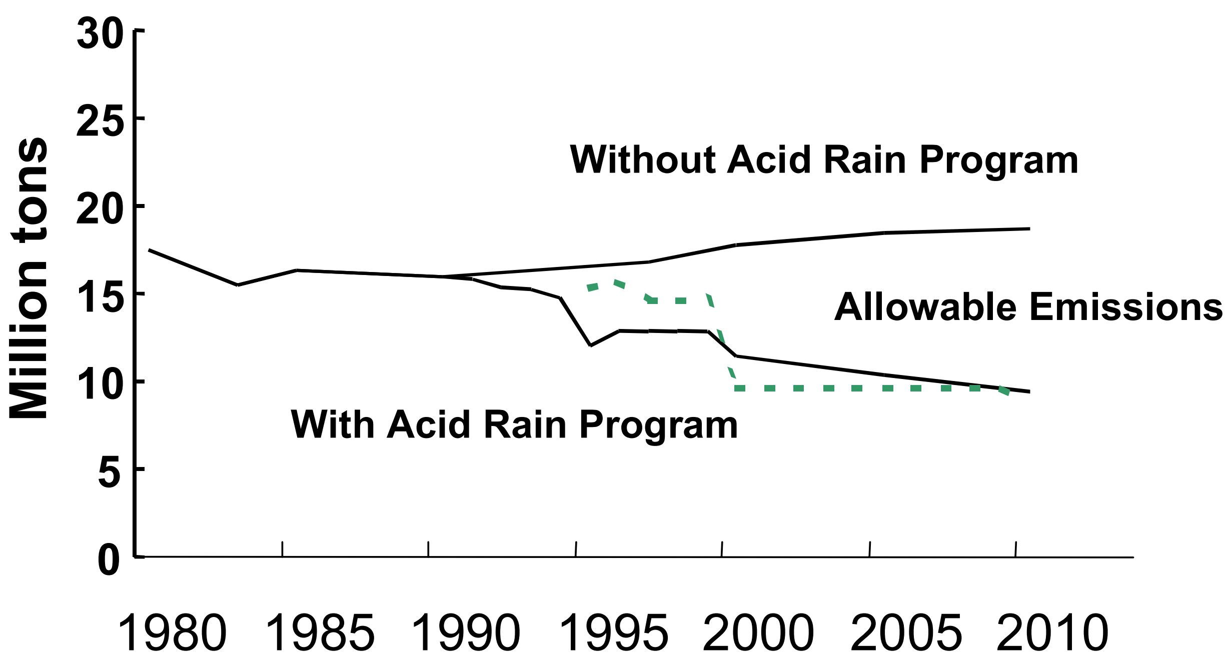
Since 1994 over 85 million $SO_2$ allowances have been traded— approximately 35% (30 million) of which were traded between economically distinct organizations, and 65% were intra-company trades not filed with EPA. EPA has executed over 9000 transactions in its ATS ($SO_2$) and NATS ($NO_x$) databases.

The acid rain trading program achieved its goals—it reduced $SO_2$ emissions faster than projected and at a lower the compliance cost. Figure 5.1 compares the projected $SO_2$ emissions from the electric power sector with and without the acid rain program. The dotted line depicts the allowable emissions under the program.

In addition to reduced emissions, and associated health and environmental benefits, the acid rain program also resulted in several additional cost savings:

- *Administrative Cost and Monitoring*—savings in government implementation of ~$10 million per year, with monitoring costs of ~$100 million (paid by the affected plants). Emission trading transaction costs were ~1% of the value of trades.
- *Cost-Effectiveness and Efficiency*—the estimated marginal cost of compliance was reduced from ~$1,500/ton of $SO_2$ in the mid-1980s (1995$), assuming forced scrubbing and imperfect trading, to ~$300/ton today when perfect trading is assumed.
- *Innovation and Dynamic Efficiency*—$SO_2$ trading induced many types of innovation: process changes, organizational innovations, reallocation of capital investment (e.g., railroads), flexibility to fully respond to exogenous changes, etc. As a result of technological change, the average cost per ton of $SO_2$ was reduced from $236/ton with 1989 compliance technology to $198/ton with 1995 technology (1995$). As the average compliance cost has been reduced the total program cost has also declined, from $2.3-5.9 billion (estimated by EPA in 1990) to ~$1 billion today (1995$).

**Figure 5.1 Projected Emissions from the Electric Power Sector**



According to EPA estimates, the cost of compliance (to date) is approximately one-third of what it projected. Many factors have contributed to this outcome. Most affected utilities switched to low sulfur coal (predominantly from the Western U.S.) or blended coals to achieve the Phase I target emission rate (2.5 lbs./MMBtu). This was possible due to deregulation of the railroad industry, which dramatically reduced the costs of transporting low-sulfur coal to previously inaccessible markets.[8] Fuel switching was used extensively by affected Phase I utilities since it provided compliance flexibility with respect to future emission requirements. Capital expenditures on FGD units were avoided until such time that more was known about compliance with other pending regulatory requirements (e.g., $NO_x$, PM, $CO_2$, etc). This strategy allowed utilities to develop a cost-effective multi-pollutant compliance strategy and prevented current compliance expenditures from becoming unrecoverable or "stranded".

Another factor was the development of coal quality monitors. These allowed a more accurate measurement of the sulfur content of the input coal and output flue gases, so that a compliance-blended coal could be burned. Some utilities elected to install FGD units (scrubbers); but they did so as part of the opt-in provision in the program. This resulted in two benefits: it provided a longer period to recover the installed capital, and earned additional emission allowances for the utility through over-compliance. These allowances were sold in the market to defray the investment costs.

The potential effect of these compliance options on emissions trading is summarized below:

- As the price of low sulfur fuels (per unit of heat MMBtu) increased relative to the price of high sulfur fuels, the price of allowances increased. An increase in this price differential is effectively an increase in the marginal cost of abatement. This differential has had an ambiguous impact on the volume of emissions trades to date.
- Installation of an FGD unit changed an emission source's position from a buyer to a (potential) seller of emission allowances. As more FGDs were installed, the increased supply of allowances should have resulted in lower allowance prices.
- As it became less expensive and easier to "re-dispatch" units, the increasing share of "cleaner", more efficient generating sources should also have contributed to lower allowance. [9]

Experience with $SO_2$ emissions allowance trading has shown that:

- Exchange of allowances between units belonging to the same operating company or holding company was being used extensively for current period compliance.
- There was relatively little trading between companies for current period compliance.

[8] In the United States, large amounts of low sulfur coal are strip-mined in the West. However, the majority of coal-burning utilities are located in the Midwest and East, where they have historically utilized high sulfur coal deep mined in the same regions. With railroad deregulation, low sulfur coal could be strip mined at relatively high altitudes in the West, and transported downhill virtually halfway across the country. The combination of low-cost mining and low-cost transport results in a lower-costs for many Midwestern and some Eastern utilities, compared with the higher costs of deep mining high-sulfur coal and installing scrubbers or other compliance technologies.

[9] Transmission issues (e.g., line losses) must be considered in re-dispatching units.

- Allowance banking was used extensively. About 30% of all allowances issued between 1995 and 1998 have yet to be redeemed. About one-half are held by parties other than utilities.
- There has been considerable trading of future period allowances.
- Allowance prices and compliance costs were lower than expected.
- Marginal abatement costs due to fuel switching were lower than expected.

### *Designing Future Emission Trading Programs*

Though more costly to establish, "cap and trade" programs (such as the $SO_2$ program) tend to be more liquid than "baseline and credit" programs. In the case of the $SO_2$ and $NO_x$ OTC "capped" markets, the commodities are relatively homogeneous, which facilitates transactions. By comparison, the $NO_x$ and VOC "open" markets are fragmented, and are burdened by lengthy credit procedures and the need for government approval of individual transactions.

Based on experience implementing the $SO_2$ and $NO_x$ trading programs, and ex post analyses, three groups of issues are relevant to the design of future trading programs:

a. Programmatic

- What sources should be included in the program?
- How will emissions be measured and reported?
- When will allocations be made and will they be reduced over time?
- What are the procedures for banking emissions?
- How will sources demonstrate compliance?
- What are the rules for offsets?

b. Administrative

- How will administrators submit allocation information?
- What standard procedures will be used for trading allowances?
- Who will administer the tracking system?

c. Individual Conditions

- How can the program be expanded?
- Will there be special treatment for low-emitting units?
- Will early opt-ins be allowed?
- How are individual allocations determined?
- What penalties should be assessed for non-compliance?

In addition, basic rules to be considered in designing a trading program include the following:

- Eliminate discretion and uncertainty
- Avoid changing the rules often or unpredictably
- Limit oversight of transactions
- Record transactions quickly, making the data easily available
- Stimulate liquidity
- Develop a futures market
- Give managing institutions clear legal authority, good technical capability, and clearly specified objectives
- Know the characteristics of the air shed and the effects of pollutants to be controlled
- Ensure that permits have some economic value
- Ensure that permit allocation is rational

### *Effect of Regulation on Emissions Market Operation*

Regulation of the power sector can affect the functioning of an emissions market in several ways. State and federal utility regulatory commissions, legislatures, and environmental protection agencies each implement legislation and regulations that could alter the ability to comply with emissions requirements or the cost of compliance.

For example, in the U.S., state public utility commissions (PUCs) regulate electricity rates such that utilities are guaranteed a rate of return on their investments. Utilities have been allowed to recover all capital and operating costs incurred (with approval of the PUC), plus a rate of return on capital. This includes capital investment in pollution control equipment.

Under a rate-of-return environment, there is little or no incentive to choose the lowest cost compliance alternative, since return of (and on) capital is guaranteed. Consequently, utilities have often invested in more expensive compliance alternatives (e.g., FGD vs. fuel switching).

However, there are some circumstances when local economic conditions might influence the selection of a compliance alternative. For instance, some states approved installation and cost recovery of FGD units to protect the associated employment, economic and social benefits of locally mined high sulfur coal.

Under regulation, all costs (fuel and installation of pollution control equipment) incurred are passed on to ratepayers (electricity customers). In many states, emission allowances have received similar treatment to fuel—all associated costs and revenues are flow-through to ratepayers.

Some states have used incentive regulation for allowance transactions and fuel-switching. For example, to encourage the use of "clean" technologies, the state of Massachusetts allows 80% of the allowance purchase cost to be recovered, but allows utilities to keep 20% of the profits from the sale of allowances outside of its rate base. To inhibit acid deposition within its boundaries, the state of New York penalizes its utilities for selling allowances to out-of-state utilities that may contribute to its acid rain problem.

Any difference in treatment of these compliance options by a state regulator creates market distortions. For example, the more FGD cost recovery is allowed, the more FGD units will be built, and the more emission allowances will be generated (due to the higher level of control by FGD units). As the supply of allowances increases, demand for allowances will decrease, and market price of allowances will fall. Conversely, restrictions on the sale of allowances (e.g., New York) will limit their market demand and tend to drive prices up. In either case, external requirements/restrictions distort the intended price signal for efficient selection of an emissions compliance option.

From a utility's perspective, the presence of allowances changes the relative cost of compliance options, since the level of control required is only that in excess of the quantity of allowances allocated. As a result, in some cases, a low-cost compliance source abates too little pollution and a high-cost source would abate too much. This is a consequence of allowance prices not reflecting the true marginal cost of abatement, so total compliance costs are higher than the hypothetical least-cost (optimal) solution for emission markets.

### *Emission Allocations*

How emission allowances are allocated is critical to the success of trading programs. Allowance allocation has a fundamental impact on the total costs of compliance that affects where, when and how electricity is generated. Emission allowances, therefore, have localized environmental impacts.

In the U.S. $SO_2$ trading program, allocations have been based on the historical emissions of each electric generating plant during a baseline period (e.g., 1985-1987). This allocation is fixed for each year during Phase I and Phase II (set at a lower level to allow for emission rate adjustments).

In the $NO_x$ trading program allocations, while similar in structure, will be updated after five years to reflect any new information regarding emission sources, compliance or science. During the first five years, allocations are made based on historical fuel use. Subsequently, EPA will update these allocations using output (generation) data and incorporating new units that have come. Use of an output allocation procedure will reward non-emitting and low emitting sources.

Today these allocated $NO_x$ allowances would be valued at ~$1.5 billion per year. However, they are being allocated at zero cost to existing power generators. As such they represent an environmental asset transfer. New sources, however, will need to buy allowances in order to generate power, making them a factor of production.

### *Establishing Commodity Markets*

For the purpose of strengthening emissions trading programs there are important lessons to be learned from an examination of other commodity markets. Electricity has been traded as a commodity for several years. Table 5.1 lists the energy exchanges where electricity and other energy commodities are traded. These exchanges serve to reduce risks inherent in competitive power and fuel markets. The following instruments are used to counteract market and price volatility: futures contracts, price swaps, options, etc..

The internet is also changing the way that energy commodity markets operate. Several electronic trading exchanges are now in business (see Table 5.2). These open platforms may become increasingly important in the future. Emissions trading, particularly GHG allowances, may also take place on this platform.

**Table 5.1 Energy Futures Exchanges**

| |
|---|
| Amsterdam Power Exchange (APX) |
| Chicago Board of Trade (CBOT) |
| Chicago Mercantile Exchange (CME) |
| International Petroleum Exchange (IPE) |
| Kansas City Board of Trade (KCBT) |
| New York Mercantile Exchange (NYMEX) |
| Nord Pool / El-Ex |
| Singapore Exchange |
| Sydney Futures Exchange (SFE) |

**Table 5.2 Electronic Energy Exchanges***

| |
|---|
| Altra's Chalkboard and Streamline |
| Automated Power Exchange |
| HoustonStreet.com |
| Intercontinental Exchange |
| RedMeteor.com |
| Swapnet |
| **Proposed exchanges in Germany, Austria and Poland in 2000* |

$SO_2$ and $NO_x$ trading markets are operational in the U.S. The $SO_2$ market, which has been in operation longer, has seen more activity than the $NO_x$ market which has experienced relatively few trades. For both markets, banking provides a link between the market for immediate settlement and risk management. For instance, in the $SO_2$ market, the presence of banked permits has helped to suppress any price spike at the onset of the more stringent emissions restrictions required in Phase II. Banking has also been key to ensuring accurate price discovery and market liquidity for allowances sold for future delivery. The same risk instruments used in commodity trading - options, futures, etc - are now used in emissions trading markets to cover price volatility and to buy/sell allowances forward.

While only proposed requirements to control GHG emissions have been developed, a few bilateral trades have already occurred. A future global GHG trading market could be on the order of billions of dollars annually. For any market to succeed, it must sustain a high volume of trades. It is not yet known if any of the emissions markets will have enough volume to be efficient.

### *Brokers' Role in Emissions Markets*

As previously noted, 65% of emissions transfers in the U.S. have been within the same company, meaning that 35% of emissions transactions were between different companies. While some of these were bilateral exchanges, many were conducted by emissions brokers—independent agents who, for a fee, help buyers or sellers of allowances locate each other.

Brokers help to create the allowance market by identifying new market participants, advising sources on transaction structures, and providing information on market prices and trades. Brokers have also helped facilitate the sale of allowances bundled or swapped with power or coal, or in other customized forms. $SO_2$ allowances for years 2006 and $NO_x$ allowances through 2002 can now be traded. Brokers can help buyers and sellers structure transactions for future settlement to balance potential risk in price, liquidity, credit and/or changing regulation.

Because of their hands-on experience with the market, brokers have interesting perspectives to offer. According to brokers, the $NO_x$ market has benefited from emissions trading experience gained in the $SO_2$ market, so that $NO_x$ market participants have generally benefited from a much quicker learning curve.

# Chapter 6

# Legal and Contractual Requirements

In a market where emissions trading is allowed, the choice of pollution control is based on financial considerations. Emitters must reduce emissions (liabilities) or hold allowances (assets) at a minimum cost, and with minimal risk.

A viable financial instruments market requires that:
- property rights be well-defined,
- property be freely transferable, nearly fungible and recordable.

The existence of a robust emissions market is evidenced by the public recording of all transactions, a shift from bilateral trades to market exchanges, the presence of investors and speculators, the use of spot and forward markets, as well as the trading of options and futures. Another sign is the packaging of allowances with other inputs—such as the packaging of allowances together with the sale of high sulfur coal.

## *Legal Prerequisites*

For a viable market to exist, any trading program must create entitlements that are irrevocable outside predefined circumstances. To create an emissions market, emissions rights must first be created.

An emission right consists of a specific private authority to emit, which can be passed on by purchase or trade, or that may be held exclusively by a private interest. Property rights are earned, created or allocated for a designated span of time. Their ownership, use and associated obligations are clear, and all temporal, geographic or substantial constraints on their use are identified. Also, property rights are accompanied by an accepted accounting method for registering transactions, with procedures for reconciliation of discrepancies and well-defined penalties and liabilities. The conditions under which rights may be forfeited, and the circumstances under which legislative bodies or regulatory agencies can cancel property rights must also be clear to all parties.

In addition to defining property rights, the market needs to be defined. Emissions trading is a commercial activity, and thus requires a consistent system of laws that allow individuals and organizations to hold and transact intangible assets such as emissions. Commercial law should also define the rights and liabilities of all parties, and provide a standardized unit of measure to trade the rights, avoiding the need for individual negotiation. The system should also designate accountability by defining the mechanism by which rights can be exercised, and should include tracking and monitoring systems. Also, a trading program cannot exist where barriers or other prohibitions exist.

The system must produce consistent, high quality data on actual emissions that is independently validated. Effective and rapid enforcement is essential to ensure the incentive to buy credits. A summary of the legal predicates for emissions trading programs is provided in Appendix B.

### *Administrative Prerequisites*

Once property rights and a commercial system are established, it is also necessary to use well-defined and enforceable emissions contracts. Contracts should include the following elements:[10]

***Clear definition of the property***—In existing emissions markets, emissions are defined such that:

- **$SO_2$**—every ton of $SO_2$ can be exchanged for any future ton of $SO_2$.
- **$NO_x$**—tons of $NO_x$ can be exchanged for any future tons of $NO_x$; however, if the bank becomes too full, tons may be used at a ratio progressively greater than 1:1.
- **GHG**—No legal definition of a GHG credit exists at this time. Therefore, the definition of property in contracts must anticipate future legal definitions of credits implied by the Kyoto Protocol mechanisms (or their replacement) and domestic laws.

***Specification of quantity and price***—These are negotiated bilaterally, or through a broker. Although derivative pricing is inexact, the necessary contract provisions are relatively simple. Where markets are thin, prices will likely be volatile.

***Indication of the time and manner of delivery***—This should include when the title transfer takes place (current delivery or future delivery), and when the allowance transfers will be recorded. Also, the contract should specify if payment will occur before or after the transfer is recorded. For $SO_2$ and $NO_x$, these are usually simple issues to be decided. However, for GHG emissions, delivery is a complex issue due to the large number of unknowns factors regarding the future shape of the market. Discussions on the CDM suggest that while project validation will occur upfront, certified emission reductions (CERs) will be recognized on a year-by-year basis, after emissions are actually avoided. Also, in some cases there is no title to pass from buyer to seller, and price uncertainty is large.

***Preconditions and Continuing Obligations***—For a valid market, participants must have the authority to transfer allowances from one party to another. For $SO_2$ and $NO_x$, this authority is specified in the program guidelines. For GHG, several preconditions need to be established. In the Kyoto Protocol and its implementing laws, baselines need to be established, and projects must be acceptable to the host country and consistent with its societal goals. Provisions must also be included to ensure the continued maintenance of any emissions reduction project. For

[10] Elements of greenhouse gas or carbon trading markets are mentioned in this chapter; these markets will be discussed in greater detail in later chapters.

$SO_2$ and $NO_x$, once the trade has been completed, all obligations end. For GHG however, it is not yet clear what obligations may continue beyond the date of the transaction. Formal responsibilities for monitoring, verification, and certification have not yet been agreed upon. Another issue that remains undecided is whether buyers or sellers will be liable if the emissions are not found to be valid at the time of reconciliation. Also, buyers would like protections against devaluation of credits.

***Non-Performance***—Contracts should also include clear indication of recourse should the seller fail to deliver credits, or should the buyer fail to pay for credits received. Also, for GHG projects, it will likely be necessary to maintain qualified status; recourse should be indicated should sellers fail to maintain this status. Buyers and sellers may both wish to take advantage of risk management tools—forward contracts, options, etc. Who bears the regulatory risk in the case of *force majeure*?

***Damages and Remedies***—Contracts should specify what termination rights a seller has as well as what right to damages a buyer has in case of default. Other factors include: how to measure lost profits/opportunity costs, what judicial or regulatory body has oversight, and who pays damages to portfolio traders.

***Dispute Resolution***—Contracts should indicate how disputes will be resolved—what laws apply and what venue—parties prefer binding arbitration or courts? For GHG markets, it is not yet known if the Kyoto Protocol will establish procedures, or how international judgments will be enforced.

## Case Study: Legal and Administrative Prerequisites for Emissions Trading in the People's Republic of China

In China, urban pollution levels are so high that the costs, measured in terms of public health, are very significant. However, China lacked any direct incentive to control air pollution. There was a need for a mechanism to reduce costs of pollution control to achieve greater emission reductions. The Asian Development Bank commissioned a study on the potential use of market-based instruments in China.

The Chinese Constitution creates a centralized government with goal-setting functions carried out from the top-down through an elaborate hierarchy of government authorities. The judicial system is under the supervision of the legislature, and consequently courts do not make law or provide judicial review of legislative actions. As a result, modern Chinese law is pragmatic and focused on producing concrete results through institutional means.

The study found no absolute constitutional or statutory barriers to use of emissions trading. But, it also found very few of the necessary legal and administrative provisions for such programs—and to establish them would require significant effort. The lesson learned is that, while benefits from trading can potentially be great, success will depend on careful development of the many administrative and legal predicates.

# Chapter 7

# GHG Emissions Reductions Programs

International global climate change negotiations have been underway for almost 10 years. Figure 7.1 highlights the key negotiating sessions.

In 1992 more than 150 nations met at the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil. At the meeting, the United Nations Framework Convention on Climate Change (FCCC) was signed by most of the nations of the world, committing all parties to consider climate change in relevant policies and actions. Developed countries and countries with economies in transition[11] committed themselves to *"… adopt national policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs."* (Article 4.2a).

No explicit action to reduce GHG emissions was required of developing countries or emerging economies. However, these countries could reduce their GHG emissions through an innovative market-based mechanism—joint implementation (JI)[12]—that was included in the FCCC on a pilot basis to reduce compliance costs in Annex I countries. JI projects are those undertaken in developing countries/emerging economies, with capital and technology provided by Annex I countries, with the objective of offsetting or reducing the GHG emissions originating in the Annex I countries. The United States and several other Annex I countries have been very active in developing JI projects.[13]

By 1995, it became apparent that Annex I countries would not meet their commitment under the FCCC. The voluntary actions, together with the effect of regulations and taxes, would not induce a sufficient change in GHG emissions to return them to 1990 levels by 2000.

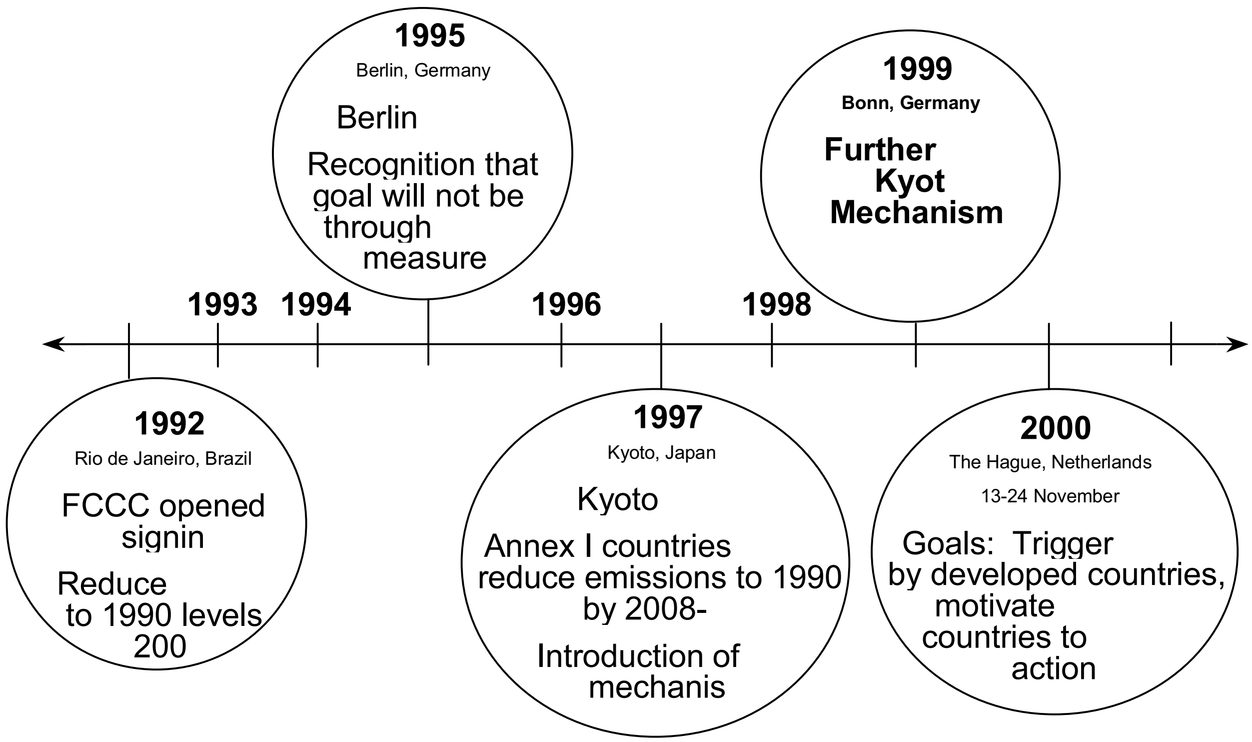
[11] Annex I countries include industrialized countries and countries in transition (underlined). These are: Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, Estonia, European Community, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom of Great Britain and Northern Ireland, and United States of America.

[12] *Those Parties may implement such policies and measures jointly with other Parties and may assist other Parties in contributing to the achievement of the objective of the Convention and, in particular, that of this subparagraph…* (Article 4.2a).

[13] The United States Initiative for Joint Implementation (USIJI) was created in 1993 as a pilot program to encourage voluntary participation by private entities in projects that could diffuse innovative technologies to mitigate climate change. The USIJI program consists of land use/forestry projects that seek to sequester carbon and energy projects that avoid or reduce emissions of greenhouse gases. USIJI criteria are consistent with criteria defining Activities Implemented Jointly (AIJ) agreed to in the Framework Convention on Climate Change.

Consequently, the Conference of Parties to the FCCC began discussing "policies and measures" that could be taken after the year 2000 to reduce future GHG emissions.

**Figure 7.1 Key Climate Change Negotiating Sessions**




*The Kyoto Protocol*

In December 1997, more than 150 countries signed the Kyoto Protocol that limits emissions of $CO_2$, $CH_4$, $N_2O$ and other greenhouse gases (GHGs). The 38 Annex I countries committed themselves to reduce emissions to an average of 5.2% below 1990 levels by 2008-2012. This will require a reduction of 3.5 billion tons $CO_2$ each year. The Protocol will become effective when signed by 55 countries whose combined total share was 55% of the world's $CO_2$ emissions in 1990.

The Protocol includes three mechanisms for trading GHG reductions between countries: Joint Implementation (JI), the Clean Development Mechanism (CDM), and emissions trading. These flexible, market-based instruments allow for price signals that: 1) recognize the value of carbon and greenhouse gases, 2) facilitate the flow of capital and technology, and 3) create flexibility in complying with emission targets.

These mechanisms are intended to minimize abatement costs and achieve greater emission reductions per compliance dollar expended. They also provide incentives for private sector participation and for "early action", and should help stimulate the flow of capital and technology across international borders.

However, these mechanisms will be effective only if countries enact measures that:

- Include market and policy components
- Utilize clear rules and transparent procedures
- Encourage market-based economy with an active private sector
- Promote accountability (national and international)
- Honor minimum conditions on transactions
- Require minimum government intervention
- Allow room for market innovation (project finance, insurance, etc.)

### *Joint Implementation (JI)*

A JI pilot program was first included in the FCCC in 1992. The program was project based, with voluntary credit transfer. Due to the concerns of non-Annex I countries, the pilot program was revised in 1995 and renamed "Activities Implemented Jointly (AIJ)", a five year pilot phase to provide experience for future development.

The geographic scope of the pilot remained the same - Annex I country JI investments in non-Annex I countries. The Kyoto Protocol in 1997 revised the scope and definition of JI as projects; it limited JI investments to within Annex I countries, and CDM was added for Annex I investment in non-Annex I countries. Under the Kyoto protocol, JI projects can encompass land-use/forestry, reforestation, biomass, clean energy and energy efficiency, fuel switching and renewable energy. Reductions in greenhouse gases are quantified as Emission Reduction Units (ERUs) and are to be apportioned between financier and host. These ERUs can only be used during 2008-2012, the first budget period, as defined by the Kyoto Protocol.

### *U.S. Initiative on Joint Implementation*

Following the 1992 FCCC Meeting, the U.S. developed the U.S. Initiative on Joint Implementation (USIJI), to implement the JI program. The goal of the USIJI was to:

- encourage the development and implementation of voluntary, cost-effective projects between U.S. and non-U.S. partners;
- reduce or sequester greenhouse gas emissions; and
- contribute to the formulation and implementation of the FCCC pilot phase for joint implementation (referred to as Activities Implemented Jointly).

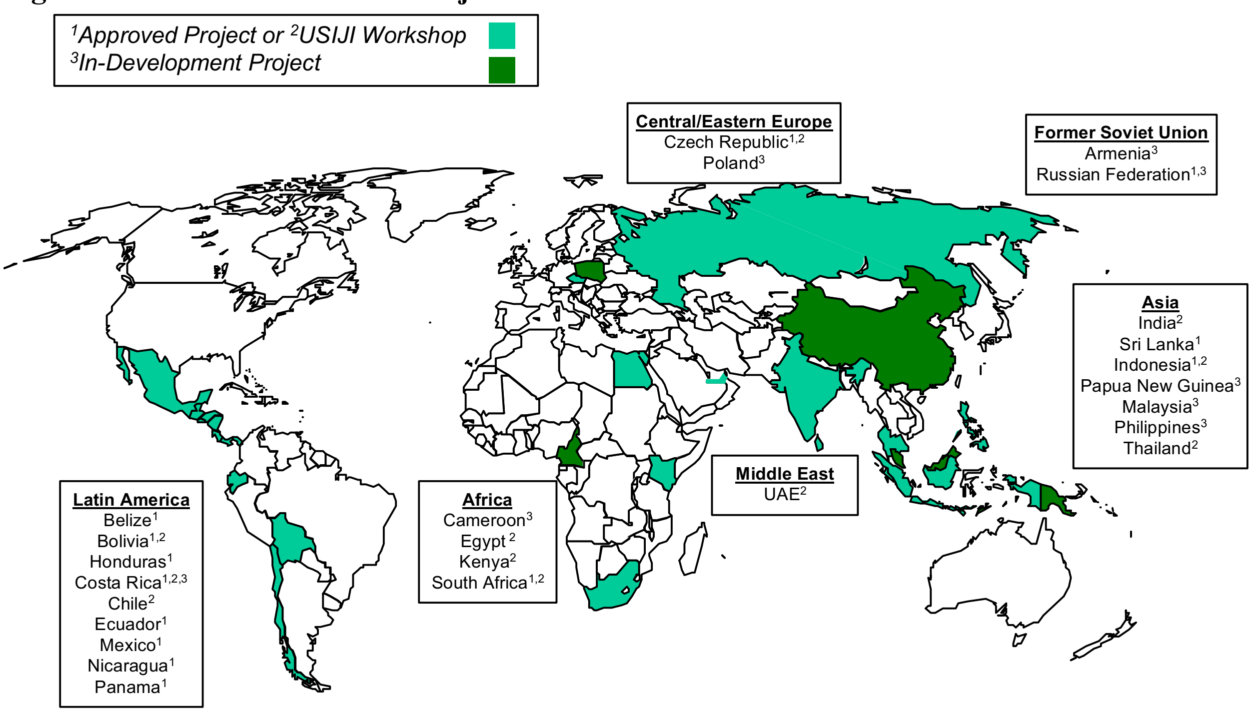
To date, the USIJI has accepted 31 projects for land-use management and forestry protection, renewable energy and energy efficiency located around the world. The projected benefit of reductions made under the USIJI is 189,383,000 million metric tons of $CO_2$ at a total estimated project cost of $534,679,000.* Twelve projects are fully financed; another twelve projects have financed part of the expected costs. Total financing committed to date is $158,288,000.

All JI projects must demonstrate additionality in three areas:

- *Emissions*—greenhouse gas reductions above and beyond those likely to occur without the project;
- *Financial*—funding independent of or in addition to the FCCC financial instrument, multilateral development bank or U.S. Government Official Development Assistance, or U.S. federal funds in excess of FY93; and
- *Programmatic*—measures initiated as a result of or in reasonable anticipation of the USIJI Program.

Also, all JI projects must include an assessment of the non-GHG impacts/benefits and report both on-site and off-site impacts/benefits. This could include local emissions (e.g., $SO_2$ and $NO_x$), human health impacts, and water, air, soil quality.

**Figure 7.2 Location of USIJI Projects**




The USIJI Secretariat works with project developers to secure a host country's acceptance, preferably through diplomatic channels. The USIJI reports projects and emissions jointly with concurrence of the host country. Based on JI projects developed by the International Utility Efficiency Partnerships, Inc. (IUEP) and others, which have received USIJI certifications, it has been determined that for JI projects to be successful, they must be credible, efficient, flexible, transparent, and verifiable, and should promote energy and emissions security. There is still

* Representing an average cost of \$2.82/metric ton $CO_2$.

significant work to be done to cope with the financial, technical and logistical barriers to project development, but the pilot USIJI has provided valuable lessons for future JI project development.

### *International Utility Efficiency Partnerships*

Another U.S. initiative to encourage voluntary actions regarding GHG emissions is the International Utility Efficiency Partnerships, Inc. (IUEP). First established in 1995 as an initiative of Climate Challenge—President Clinton's Climate Change Action Plan, the IUEP is an affiliate of the Edison Electric Institute (EEI) charged with identifying international energy project development opportunities and supporting JI project investment. IUEP has focused on identifying large international power development and investment opportunities, in addition to the worldwide momentum for developing environmentally sound activities. IUEP receives financial and political support from multilateral institutions and works with governments, industry and investors to educate them on the importance of sustainable development and viability of environmentally sound technologies.

The IUEP recently established the International Climate Change Project Fund (ICCPF). The ICCPF is a collaborative partnership between The United States Agency for International Development (USAID), the United States Energy Association (USEA) and the International Utility Efficiency Partnerships, Inc. (IUEP). The objective of the ICCPF is to provide funding support to U.S. investor-owned utilities, their subsidiaries, and other investor owned energy companies that are seeking to assess and implement specific projects to avoid, reduce, and mitigate the climate impacts of GHG emissions in USAID-assisted countries in Asia, Africa & Latin America. The Fund will provide support of pre-investment project analyses with a targeted financial contribution provided by USAID. The ICCPF would contribute up to $100,000 per analysis. The selected projects must be likely for follow-on funding from private sector financial institutions, export credit agencies and/or multilateral development institutions.

The Fund may support a wide variety of climate change mitigation projects including and not limited to the following:

- Fuel System Actions
- Conventional Power Generation System Actions
- Transmissions System Actions
- Distribution System Actions
- End Use Energy Efficiency & Demand-Side Management Actions
- Renewable Energy Actions
- Offset Actions and Emissions Trading Actions

Eligible recipients of the Fund must be U.S. investor-owned utilities, their subsidiaries, and other investor-owned energy companies. Eligible recipients must be in a position to invest, develop, or otherwise implement the proposed climate change mitigation project.

The following projects have been selected for funding under the June 1, 2000 - RFP:

| Applicant | Project Description | Country | $CO_2$ Benefit (Millions MT $CO_2E$) | Total Project Cost ($Millions) | Amount Funded |
|---|---|---|---|---|---|
| Tenaska LLC (Nebraska) | Hydroelectric | Bolivia | 10 | 97 | $81,000 |
| Onsite Sycom (CA) | Wind Power | Panama | 21 | 28.1 | $81,000 |
| EPS Asia Inc. (Pennsylvania) | Energy Services Company | India | .312 | .470 | $79,206 |
| Electrotek (Virginia) | Smart Monitoring & Control System Efficiency | Senegal | .315 | 1.7 | $70,875 |
| **Totals** | | | **31.627** | **127.270** | **$312,081** |

Only a few, bilateral trades have taken place to date, but these are worth noting. Even though credits have no market value without establishment of an international trading regime, parties selling $CO_2$ emissions are able to create cash flow and capture revenue now through the public relations value of their actions or the ancillary benefits that arise from the $CO_2$ action undertaken.

### *Clean Development Mechanism*

The CDM was introduced in Article 12.2 of the Kyoto Protocol, which states that the

*"…purpose of the clean development mechanism [is] to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties in Annex I in achieving compliance with their quantified emissions limitation and reduction commitments…"*

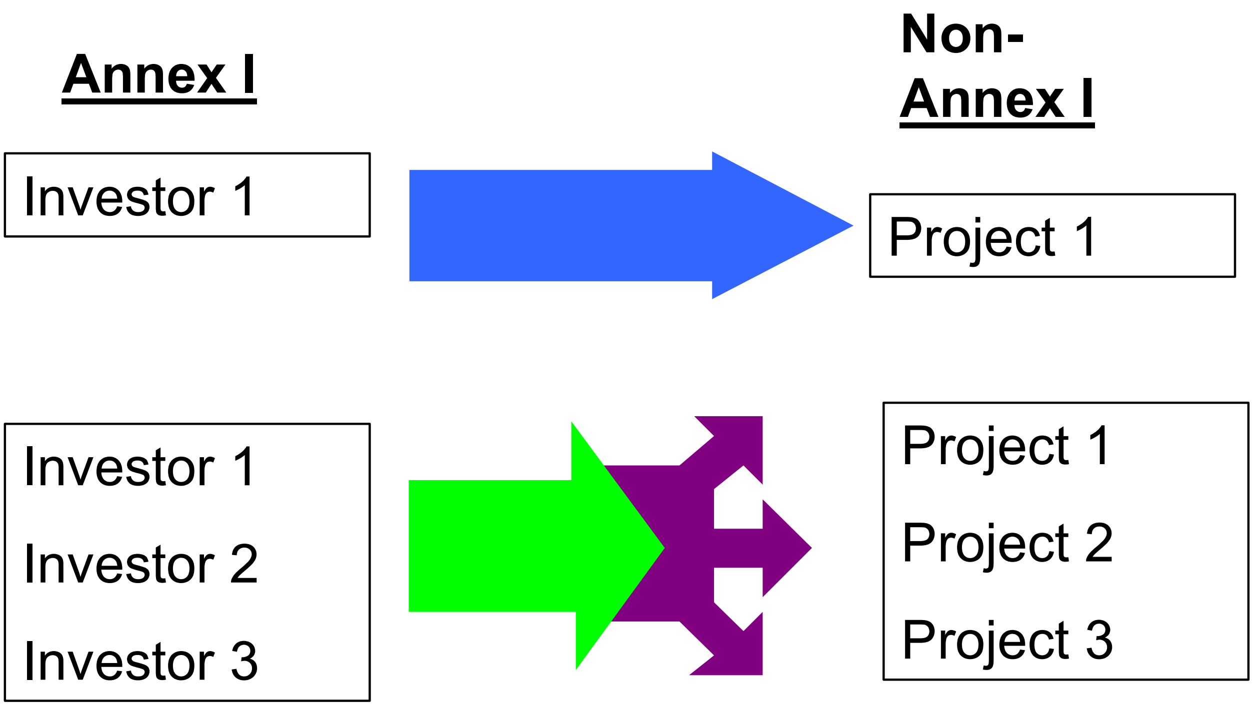
The CDM allows developed (Annex 1) countries to invest in low-cost abatement opportunities in developing countries and receive credit for the resulting emissions reductions. Of all the Kyoto Mechanisms, CDM is the only instrument in which Annex I *and* non-Annex I countries can jointly participate. All participation is voluntary. The CDM is an integral part of Annex I compliance targets, and not merely supplemental.

Although the rules for the CDM remain undefined, projects may include either bilateral projects hosted by Annex I or non-Annex I countries, or portfolio projects where CERs are deposited in a CDM "bank." However, until the rules are established, the potential value of credits is not known.

It is anticipated that all projects will generate Certified Emission Reductions (CERs) for investors that can be used during the first compliance period 2008-2012. Once these are verified and certified, the CERs can be traded.

Non-Annex I countries should also receive significant benefits from participating in CDM projects. Emissions reduction projects should offer a wide range of sustainable development benefits that overlap closely with goals identified by host developing countries. For this reason and others, there are significant incentives for interested parties to develop projects for eventual CDM consideration.

**Figure 7.3 CDM Projects**




*World Bank Programs*

The World Bank is involved with a number of activities to encourage development of GHG emissions reduction projects. These include:

- *Carbon Investment Fund (CIF)*—series of funds tailored to investor and client country needs with a geographical, sectoral or technical focus.
- *Carbon Neutral Products*—development of funds designed to tap green consumers willingness to pay for neutralizing climate change impacts of consumption (i.e., marketing carbon-neutral gasoline).
- *Specific-Purpose Funds*—must be justified by size and nature of a project, which prevent it from being directly linked to a general CIF (i.e., investments in a particular region or investments in a particular sector).
- *Specific Services*—baseline assessment, legal advice, project identification, etc.

The World Bank is also the sponsor of a Prototype Carbon Fund (PCF), designed to help create a market for carbon offsets within the framework of the Kyoto Protocol by:

- demonstrating how CDM and JI trade can contribute to sustainable development
- providing "learning by doing" experience for Parties to the Protocol on key policy issues (e.g., defining and validating baselines)
- building confidence that the trade can benefit both sellers and buyers.

The Fund currently has over $150 million committed, but does not yet have support from several key countries. Potential investors are waiting for more of the terms to be defined, before they make a commitment to participate. An important issue to be resolved is whether investors are purchasing an equity stake in the project itself, or whether they are buying an interest in the carbon credits generated by a project. It is also not yet clear what body will set the rules for and/or control funding for carbon reduction projects in the future—some potential investors do not support the World Bank's interest in assuming such a role.

Another World Bank-managed service is the Energy Sector Management Assistance Program (ESMAP). This program allows energy specialists to share knowledge and practical lessons on energy efficiency issues. It also provides technical assistance for

- promoting access to energy in rural areas and under-served households,
- mainstream renewable energy technologies,
- encouragement of more energy efficient practices,
- facilitating international energy trade.

### *GHG Emissions Trading*

Under the Kyoto Protocol, all six GHGs are eligible to be traded in an international system—although $CO_2$ has been the focus of most discussions to date. Under the protocol each country is assigned an emission budget with an allocation of permits equivalent to its assigned budget. Countries that reduce their GHG emissions below 1990 levels can "trade" their excess "allowances" domestically or internationally. An international trading system would likely be an allowance-based trading system, in which the number of allowances is finite, so the price of each allowance would be determined by market supply and demand.

While the rules, modalities and procedures have yet to be fully specified for international emissions trading (or any other instrument: joint implementation or clean development mechanism), players in both developed (Annex 1) and less developed (non-Annex 1) countries have already taken proactive steps to develop projects and exchange emission credits.

Although limited in number, a few notable bilateral trades have taken place to date. Even though credits have no market value without establishment of an international trading regime, parties selling $CO_2$ emissions are able to create cash flow and capture revenue now through the public relations value of their actions or the ancillary benefits that arise from the $CO_2$ action undertaken.

A number of significant issues remain to be settled before a viable international trading system can be established. Among the principal questions to be answered are the following:

- How will trading mechanisms be implemented?
- Who will play administrative and management roles—and what are the roles to be played by international bodies, operating entities, private parties, and host nations?
- Who owns the credits?
- Who has the right to enter into a contract for GHG credits—private parties? Public parties?

For the market to be worth operating, the efficiencies gained by using a trading system should be greater than the administrative costs to operate it.

### *Private Sector Investment Criteria*

Policy makers will need to address several questions in order to ensure the involvement of the private sector, whose participation is essential to the investment and technology transfer envisaged in JI and CDM. For an effective trading system, questions to be addressed include:

- Can the Kyoto Mechanisms be defined as standardized asset, with regulation, accountability and oversight?
- Is there a projected demand for such instruments?
- Are barriers-to-entry low?
- How secure is the investment environment? Can CDM investment opportunities be linked to existing or proposed commercial opportunities?
- Are the projects commercially viable, providing a risk adjusted return on capital?
- Do CDM activities add substantial costs to the development of a project?
- What is the selling price of CERs? (less important than costs to generate CDM reductions)

### *Developing Countries Considerations*

Developing countries anticipate a mixed outcome from the Kyoto Mechanisms. Viewed from their perspective are the following advantages and disadvantages:

Advantages

The mechanisms provide for:

- New sources of capital
- Cleaner DFI
- Local ancillary benefits
- Opportunities to participate in new markets
- Capacity building

Disadvantages

The mechanisms will:

- De-emphasize reducing GHG emissions by Annex I countries
- Require experience with market-based mechanisms
- Encourage projects with the most reductions achieved for the least cost per ton to be quickly performed; later reductions will increase in price.

# Chapter 8

# Summary

This Best Practices report provides a synopsis of the three-week course, *Market-Based Instruments for Environmental Protection*. An attempt was made to highlight 1) the underlying theory of market-based instruments, and 2) experience to date in the design, development and implementation of cap and trade programs in the United States. The $SO_2$ trading program is geographically the largest and most publicized operating emissions trading program. A "model" trading program has been proposed for $NO_x$ emissions under the SIP Call. Similarly, an open-market trading scheme for $CO_2$ has been outlined for the U.S.; however, important modalities and procedures must be developed before such a program can be implemented internationally.

The steps to be undertaken for an effective emissions trading program depend on the country, emission sources and pollutant(s) being examined. However, the general scope of required activities should include the following:

1. Emission Source Inventory - determine level of emissions by source and time period, together with degree of current control.
2. Emissions/Concentration Target - based on human health or environmental data determine an "acceptable" level of concentration and/or emissions. Level should consider the marginal cost of control (MAC), and ability/willingness-to-pay for pollution reduction.
3. Property Rights - tradable commodities must be created which represents the right-to-emit. The permit must have unlimited duration in order to provide long-term certainty, which is needed to induce firms to invest in control technologies and create secondary markets in which to compare the cost of control versus trading.
4. Allowance Markets - markets must be formed in which to buy/sell allowances with clear price signals. Two different markets are possible: internal trading within a plant or between plants owned by the same firm, or external trading between different firms. The success of a trading market depends on the number of participants in market, technological conditions, profit incentives, the initial distribution of trading rights and any geographical limits on trading.
5. Established Rules Governing Trading - a trading market needs: information to locate available emission permits, stable rules (changes introduce uncertainty and discourage participation), simplicity/clarity (with limited regulatory oversight), and enforcement of the rules.

Based on U.S. experience implementing the $SO_2$ and $NO_x$ trading programs, and retrospective analyses of these programs, the following issues were identified as important when designing future trading programs. The issues are divided into three groups:

*Programmatic*

- What sources should be included in the program?
- How will emissions be measured and reported?
- When will allocations be made and will they be reduced over time?
- What are the procedures for banking emissions?
- How will sources demonstrate compliance?
- What are the rules for offsets?

*Administrative*

- How will administrators submit allocation information?
- What standard procedures will be used for trading allowances?
- Who will administer the tracking system?

*Individual Conditions*

- How can the program be expanded?
- Will there be special treatment for low-emitting units?
- Will early opt-ins be allowed?
- How are individual allocations determined?
- What penalties should be assessed for non-compliance?

In addition, the following are important elements that must be addressed by decision-makers and regulators to ensure a successful emission trading market. These include:

- Eliminate discretion and uncertainty
- Avoid changing the rules often or unpredictably
- Limit oversight of transactions
- Record transactions quickly, making the data easily available
- Stimulate liquidity
- Develop a futures market
- Give managing institutions clear legal authority, good technical capability, and clearly specified objectives
- Know the characteristics of the air shed and the effects of pollutants to be controlled
- Ensure that permits have some economic value
- Ensure that permit allocation is rational

An emissions trading market for $SO_2$ and $NO_x$ can be established in most countries if property rights exist and there is a clear definition of the property (ton of $SO_2$ or $NO_x$ emission). However, since $CO_2$ (and other greenhouse gases, GHGs) are global and cumulative in their effect, a legal definition of GHG credits must be established before a trading program can exist. Therefore, any bilateral contract (or multi-lateral trading system) that exchanges GHG credits in advance of a global agreement must anticipate future legal definitions of credits as implied by the Kyoto Protocol mechanisms (or their replacement) and domestic laws.

# Bibliography

*The following list of references was compiled for distribution to participants in the Workshop on Market Approaches to Environmental Protection. The list is not comprehensive, but rather reflects the suggestions of the various instructors who participated in the course.*

*A Developing Country Business Perspective on the CDM*, for Argentine Business Council for Sustainable Development, November 1998.

"A Gush of Middle Men," Corporate Risk management, April 1991.

"A New Source of Project Finance Capital Through Energy Derivatives," Occasional Paper April 1993, ICEED, University of Colorado.

"A New Standard of Performance: An Analysis of the Clean Air Act's Acid Rain Program," (with Byron Swift), 1996, *Environmental Law Reporter*, 26 (8), (August), 10411-10423.

*Acid Rain Compliance Strategies for the Clean Air Act Amendments of 1990,* United States Energy Information Administration, March 1994.

Bailey, Elizabeth M., "Allowance Trading Activity and State Regulatory Rulings: "Evidence from the U.S. Acid Rain Program," working paper 96-002, MIT Center for Energy and Environmental Policy Research, March 1996.

Bohi, Douglas R. and Burtraw, Dallas, "Utility Investment Behavior and the Emissions Trading Market," *Resources and Energy*, 14 (1992) pp.129-153.

Bohi, Douglas R., and Dallas Burtraw, 1997. "$SO_2$ Allowance Trading: How Do Expectations and Experience Measure Up?" *The Electricity Journal 10* (7): 67-77.

Carlson, Curtis, Dallas Burtraw, Maureen Cropper, and Karen Palmer. July 1998. "$SO_2$ Control by Electric Utilities: What Are the Gains from Trade?" Resources for the Future Discussion Paper 98-44. Washington, DC.

Coggins, Jay S. and Vincent H. Smith, "Some Welfare Effects of Emission Allowance Trading in a Twice-Regulated Industry," *Journal of Environmental Economics and Management*; 25:1993 pp.275-297.

"Consumers Is Participation in NYMEX - Beating Oil and Jet Fuel," Energy in the News, Fall 1990.

*Cooperative Mechanisms Under the Kyoto Protocol – The Path Forward*, Environmental Defense Fund (June 1998).

*Cost and Quality of Fuels (Various Years),* United States Energy Information Administration.

Denne, Tim, *Aggregate Versus Gas by Gas Models of Greenhouse Gas Emissions Trading*, Scoping Paper No. 6, Center for Clean Air Policy (June 1999).

*Design and Operations of the Proposed Clean Development Mechanism*, for the President of the World Business Council for Sustainable Development, Geneva, June 1998.

*Designing the CDM to Capture Market Efficiencies and Address Developing Country Equity Concerns with a Focus on India*, for Confederation of Indian Industry, 1999.

Edmonds, J. 1998. "We Need Some New Ideas," *Climatic Change,* 38(2):129-132.

Edmonds, J. 1999. "Beyond Kyoto: Toward A Technology Greenhouse Strategy," *Consequences.*

Edmonds, J., H.M. Pitcher, D. Barns, R. Baron, and M.A. Wise. 1995. "Modeling Future Greenhouse Gas Emissions: The Second Generation Model Description," in *Modelling Global Change*. United Nations University Press, Tokyo, JAPAN.

Edmonds, J., M. Wise, D. Barns. 1995. "Carbon Coalitions: The Cost and Effectiveness of Energy Agreements to Alter Trajectories of Atmospheric Carbon Dioxide Emissions," *Energy Policy*, 23(4/5):309-336.

Edmonds, J., Wise, M. and Dooley, J. 1997. "Atmospheric Stabilization and the Role of Energy Technology," in *Climate Change Policy, Risk Prioritization and U.S. Economic Growth*, C.E. Walker, M.A. Bloomfield and M. Thorning (eds.). American Council for Capital Formation, Washington DC.

Ellerman, A. Denny, Richard Schmalensee, Paul L. Joskow, Juan Pablo Montero, and Elizabeth M. Bailey. 1997. Emissions Trading Under the U.S. Acid Rain Program: Evaluation of Compliance Costs and Allowance Market Performance." Center for Energy and Environmental Policy Research, MIT. Cambridge, MA.

"Emerging North American Electricity Markets," Natural Gas Hedger, September 1994.

*Emissions Trading Under The U.S. Acid Rain program: An Evaluation of Compliance Costs and Allowance Market Performance,* A. Denny Ellerman, Richard Schmalensee, Paul L. Joskow, Juan Pablo Montero and Elizabeth M. Bailey. MIT Center for Energy and Environmental Policy Research, 1997.

"Environmental Risk Enters the Oil Markets," NYMX Energy in the News, Spring 1994.

*Estimate of Demand for and Supply of GHG Emissions Reductions and Factors that will Influence Demand and Supply*, for Ministry of Foreign Affairs, Government of Argentina, October 1998.

Evans, Matt, *Designing an Emissions Trading Market*, Power Economics (January 2000).

*Experience with Emission Baselines under the AIJ pilot phase,* OECD Information Paper, www.oecd.org/env/cc/freedocs.htm (April 1999).

*Financing Waste-to-Energy Projects in India through AIJ*, presented at the International Workshop on Waste-to-Energy, Confederation of Indian Industry and Ministry of Non-Conventional Energy Sources, Delhi, India, August 7-8, 1997.

Firm Incentives to Promote Technological Change in Pollution Control," Journal of Environmental Economics and Management, Vol. 17, No. 3, 1989, pp. 247-265 (co-author: Scott Milliman).

Fish, A.L., and D.W. South, *Industrialized Countries and Greenhouse Gas Emissions: Previous Positions and Future National Plans*, Journal of International Environmental Affairs, 6(2) (Winter 1994).

"Gas Futures Grow Up," Petroleum Economist, March 1991.

*Green Paper on Greenhouse Gas Emissions Trading within the European Union*

*Greenhouse Challenge Vegetation Sinks Workbook: Quantifying Carbon Sequestration in Vegetation Management Projects* Greenhouse Challenge Office, Australia, 1998 (with FORTECH Pty.).

- *Greenhouse Gas Inventory Reference Manual. Volume 3.*
- *Greenhouse Gas Inventory Reporting Instructions. Volume I.*
- *Greenhouse Gas Inventory Workbook. Volume 2.*

Grubb, M., J. Edmonds, P. ten Brink, and M. Morrison. 1993. "The Costs of Limiting Fossil-Fuel $CO_2$ Emissions: A Survey and Analysis," *Annual Review of Energy and Environment. 18*:397-478.

*Guidelines for Identifying and Structuring Greenhouse Gas Emission Reduction Projects in Developing Countries,* International Finance Corporation, 1999.

Hahn, Robert W. and Gordon L. Hester*, Where Did All the Markets Go? An Analysis of EPA's Emissions Trading Program,* The Yale Journal on Regulation (1989)

Hahn, Robert W. and Robert N. Stavins, *What Has Kyoto Wrought? The Real Architecture of International Tradable Permit Markets*, Discussion Paper 99-30, Resources for the Future (March 1999).

Hamilton, Clive, *The Evolution of the Global Market for Greenhouse Gas Emissions Allowances*, The Australian Institute (August 1998).

Hargrave, Tim and Jurgen Lefevere, *Compliance-related Aspects of Greenhouse Gas Emissions Trading in the EU*, Scoping Paper No. 7, Center for Clean Air Policy/FIELD (June 1999).

Hargrave, Tim, *Identifying the Proper Incidence of Regulation in a European Union Greenhouse Gas Emissions Allowance Trading System*, Scoping Paper No. 5, Center for Clean Air Policy (June 1999).

Holtsmark, Bjart J., *A Comparison of Taxes and Tradable Permits in National Climate Policy*, Working Paper 1999:8 (September 1, 1999)

"How will the World Development of Energy Derivatives Affect Utilities in Particular and the Natural Gas Industry as a Whole," Natural Gas Focus, October/November 1994.

http://www.ipcc.ch/pub/guide.htm

http://www.ipcc-nggip.iges.or.jp/public/gl/invs1.htm http://www.unfccc.de, official documents of the United Nations Framework Convention on Climate Change.

"Increasing Environmental Imperatives Impact an International Oil Trade Patterns,"Oil and Gas News, November 21-27, 1994.

IPCC/OECD/IEA, Houghton,J.T. et al (eds); *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories*, UK Meteorological Office

Jepma, Catrinus J., ed., *The Feasibility of Joint Implementation*, Kluwer Academic Publishers, Boston.

Kerr, Suzi, et al., *Allocation of Greenhouse Gas Reduction Responsibilities Among and Within the Countries of the European Union*, Scoping Paper No. 5, Center for Clean Air Policy (June 1999).

Kosobud, R.F., T.A. Daly, D.W. South and K.G. Quinn, *Tradable Cumulative $CO_2$ Permits and Global Warming Control*, The Energy Journal, Volume 15 (N2) (1994).

Kuik, O., P. Peters and N. Schrijver, eds., *Joint Implementation to Curb Climate Change: Legal and Economic Aspects*, Kluwer Academic Publishers, Boston.

*Lessons from the World Bank for the Kyoto Mechanisms: A Review of World Bank Reports*, Final Report, Reference 5926, Environmental Resources Management (April 1999).

Lile, Ron and Burtraw, Dallas, "State-Level Policies and Regulatory Guidance for Compliance in the Early Years of the $SO_2$ Emissions Allowance Program," Discussion Paper 98-35, Resources for the Future, May 1998.

Loeb, A.P., "Deciding Fuel Quality in India: Lessons from Two Case Studies on Lead Reduction," presented at Auto Expo '98, New Delhi, India, January 16, 1998; republished in proceedings May 1998.

Loeb, A.P., "Lessons from the Lead Credit Market Applicable to Greenhouse Gas Trading," presented before Environmental Law Institute, Washington, D.C., December 2, 1997; reviewed in *The Environmental Forum*, January/February 1998, at 54.

*Operationalizing Additionality: A Reference for Project Developers*, for Greenhouse Gas Emissions Reduction Trading Pilot, British Columbia, 1999.

Pepper, W.J., J. Leggett, R.J. Swart, J. Wasson, J. Edmonds, and I. Mintzer. 1992. *Emissions Scenarios for the IPCC: An Update -- Assumptions, Methodology, and Results*. Intergovernmental Panel on Climate Change. Geneva, Switzerland.

Petsonk, Annie, Daniel J. Dudek, and Joseph Goffman, *Market Mechanisms and Global Climate Change: An Analysis of Policy Instruments*.

Presentations from Conference on Domestic Emission Trading, Center for Economic Analysis, Center for International Climate and Environmental Research – Oslo (February 11, 1999).

Presentations from Conference on International Emission Trading, Center for Economic Analysis, Center for International Climate and Environmental Research – Oslo (June 17, 1999).

*Progress Report on International Business Action on Climate Change*, with recommendations for an enabling framework for private investment in international GHG mitigation projects, for the World Business Council for Sustainable Development, Geneva, July 1996.

Raufer, Rogert K. and Stephen L. Feldman,. *Emissions Trading and What It May Mean For Acid Deposition Control,* Public Utilities Fortnightly (August 16, 1984)

*Recommendations and Strategy for Promoting Action on Climate Change by Indian Industry*, Confederation of Indian Industry, October 1997.

Report to the Chairman, Committee on Public Works and Transportation, House of Representatives, *Pollutant Trading Could Reduce Compliance Costs If Uncertaities Are Resolved*, GAO/RCED-92-153, (June 1992).

Richels, R. and J. Edmonds. 1995. "The Economics of Stabilizing Atmospheric $CO_2$ Concentrations," *Energy Policy*, 23(4/5):373-78 (6 pages).

Rose, Kenneth. 1997. Implementing an Emissions Trading Program in an Economically Regulated Industry: Lessons from the $SO_2$ Trading Program. In *Market-Based Approaches to Environmental Policy: Regulatory Innovations to the Fore*, Richard F. Kosobud and Jennifer M. Zimmerman (eds.). New York: Van Nostrand Reinhold.

*Seeking a Competitive Advantage for Central America in Selling and Marketing Greenhouse Gas Reductions: Recommendations based on a Survey of Potential Investors*, with Center for Sustainable Development in the Americas, 1999.

Smith, Anne E. , Jeremy Platt, and A. Denny Ellerman. 1998. "The Cost of Reducing $SO_2$ (It's Higher Than You Think)." *Public Utility Fortnightly* (15 May): 22-29.

"$SO_2$ Allowance Trading: How Do Expectations and Experience Measure Up?" (with Douglas R. Bohi), 1997, *The Electricity Journal,* vol. 10, no. 7 (August/September), 67-75.

Sotkiewicz, Paul M. "Public Utility Commission Regulation of Electric Utilities: Impacts on the Sulfur Dioxide Market and Compliance Costs," Ph.D. Dissertation, Department of Economics, University of Minnesota, forthcoming in 2000.

South, D.W. and R. Camp, *Business Opportunities from Climate Change*, client briefing (October 1999).

South, D.W. and R. Camp, *Emissions Trading: Design and Implementation Characteristics of U.S. Programs*, client briefing (October 1999).

South, D.W., *Emerging Options for $CO_2$ Compliance - Offsets, Trading and the CDM*, presented at the 23rd International Technical Conference on Coal Utilization and Fuel Systems, Clearwater, FL (March 1998).

South, D.W., *International Greenhouse Gas Trading: Questions and Issues for Resolution*, Energy Resources International, Inc. client briefing (June 1998).

South, D.W., *Looking Ahead: Our Energy Future*, The Washington Post (November 2, 1998).

South, D.W., *Private Sector Views Regarding CDM Investment*, presented at the International Federation of Industrial Energy Consumers (IFIEC) (November 1998).

South, D.W., *Profiting from Global Climate Change*, presented at the Environmental Exports Outlook '99 (November 1998).

South, D.W., R. Camp, J.S. Siegel and T.B. Meade, 1999, *Handbook of Climate Change Mitigation Options for Developing Country Utilities and Regulatory Agencies*, U.S. Energy Association and U.S. Agency for International Development (June). Also available online at *http://www.usea.org/Climatechange/index.html.*

South, D.W., *The Implications of Emissions Trading on Policy and Technology Choices*, presented at the Sixth Clean Coal Technology Conference, Reno, NV (April-May 1998).

Swap Transactions and other Derivatives Can Increase Markets for Natural Gas," Natural Gas Monthly, October 1993.

The Car, Its Fuel, Air Pollution and Regulation: A Study of Environmental Law, Economics and Health Policy in the Twentieth Century, manuscript; proposal approved by The Brookings Institution; expected publication date 2001.

"The Challenge of Incorporating Environmental Quality and Natural Resource Availability into the National Accounts," Global and Planetary Change, forthcoming

*The Effects of Title IV of the Clean Air Act Amendments of 1990 on Electric Utilities: An Update,* United States Energy Information Administration, March 1997.

"The Feasibility of Incorporating Environmental Quality and Natural Resource Availability Into the National Accounts" in National Academy of Sciences, Assigning Economic Value to Natural Resources (National Academy of Sciences, 1994)

"The Rise of Power Traders," Natural Gas Hedger, December/January 1995.

Titetenberg, Tom, Michael Grubb, Axel Michaelowa, Byron Swift and ZhongXiang Zhang, *International Rules for Greenhouse Gas Emissions Trading: Defining the Principles, Modalities, Rules and Guidelines for Verification, Reporting and Accountability*,

U.S. Department of Commerce International Trade Administration, *Markets for Climate Change Mitigation Technologies and Services in Developing Countries*, 2000.

U.S. EIA's URL: www.eia.doe.gov

U.S.-Brazil Global Forum, May 1999, The Aspen Institute.

Vrolijk, Christiaan, *The Kyoto Protocol: Implications for the Electricity Sector*, Power Economics (January 2000).

Winebrake, James J., Farrell, Alexander E., and Bernstein, Mark A., "The Clean Air Act's "Sulfur Dioxide Emissions Market: Estimating the Costs of Regulatory and Legislative Intervention" *Resource and Energy Economics*, 17:1995 pp. 239-260.

Wuebbles, D. and Edmonds, J. 1991. *A Primer on Greenhouse Gases*, Lewis Publishers, Chelsea, MI.

Yamin, Farhana and Jurgen Lefevere, *Designing Options for Implementing an Emissions Trading Regime for Greenhouse Gases in the EC*, Final Report, Foundation for International Environmental Law and Development (February 22, 2000).

# Appendix A:  State and Local Trading Programs

| State | Program Name | Implementing Agency | $NO_x$ | $SO_2$ | Other | Description | Sources | Status | Goal | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| California | Interchangeable Air Pollution Emission Reduction Credits | California Air Resources Board (CARB) | X | X | X | Sets general requirements that local air pollution control districts and air quality management districts must meet when developing rules for generation and/or use of credits. | Stationary Mobile Area | May 22, 1997 | Facilitate use of ERCs as a compliance alternative for meeting local control requirements. | Applicable only to districts that use ERCs for purposes other than offsets for NSR. Establishes a uniform credit currency (lbs of pollutant/year generated) to standardize and facilitate credit trading. Credits are expected to be used primarily by stationary sources, but may be generated by stationary, mobile or area sources. All criteria pollutants are eligible except air toxics, which may only be used interchangeably if authorized by Federal and state regulations. |
| Colorado | Emissions Trading and Banking | Colorado Department of Health and Environment, Air Pollution Control Division | X | X | X | Banking and trading of ERCs. | Stationary Mobile Area | Adopted 24 October 1996 but effective only when approved by U.S. EPA as a SIP revision. | | ERCs can be both permanent (tons/year) and temporary (tons). Mobile source ERCs are considered temporary. The Air Pollution Control Division operates an electronic bulletin board listing available ERCs and other necessary information. |
| Connecticut | $NO_x$ Emission Reduction Credit Trading Program | Connecticut Department of Environmental Protection | X | | | Voluntary trading and banking of $NO_x$ ERCs. Mass-based emissions and rate-based. | Stationary Mobile | mid-1995 | | |
| Delaware | Emission Banking and Trading Program | Delaware Department of Natural Resources and Environmental Control | X | | X | Voluntary; reductions from sources >1 ton are eligible if determined to be real, surplus, permanent, quantifiable and enforceable. | Stationary Mobile Area | December 1, 1996 | | |

# Appendix A: State and Local Trading Programs

| State | Program Name | Implementing Agency | $NO_x$ | $SO_2$ | Other | Description | Sources | Status | Goal | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Louisiana | Emission Banking and Trading Program | Lousiana Department of Environmental Quality | X | | X | ERCs and MERCs = 1 ton of emission reductions/year can be used as NSR offsets and in netting. | Stationary Mobile Area | August 20, 1994 | | |
| Maine | Offset Trading Program | Maine Department of Environmental Protection | X | | X | Permanent emission reductions generate offset credits that can be used against new or upgraded sources. | Stationary | Pending approval. | | |
| Massachusetts | Innovative Market Program for Air Credit Trading (IMPACT) | Massachusetts Department of Environmental Protection | X | | X | Voluntary banking and trading program. Reductions after 31 December 1990 that are real, quantifiable, surplus, enforceable and permanent are eligible for ERC certification. | Stationary Mobile Area | January 1, 1994 | | |
| Michigan | Emission Trading Program | Department of Environmental Quality | X | X | X | Voluntary, open-market program trading ERCs for all criteria pollutants. ERCs are discounted 10% (clean-air benefit contribution); ERCs generated 1991-1996 are discounted 50%. Also, for ozone-related ERCs (VOCs and NOx), an additional 10% is discounted for every year (ozone season) use is deferred. | Stationary Mobile Area | Fall 1998 | NAAQS Attainment | ERCs must be real, surplus, enforceable, permanent, quantifiable. Allowable activities include installation/modification of control equipment and more. ERCs can be used for offsets/netting and RACT compliance. Credits are self-certified by sources. On-line registry is available for public review. |
| New Hampshire | Emissions Reduction Credits Trading Program | New Hampshire Department of Environmental Services | X | | X | Open market trading system for ERCs. ERCs are rate-based units representing continuous, permanent emission reductions. | Stationary Mobile Area | January 20, 1997 | Lower costs of compliance and promote economic development. | ERCs can be generated by stationary, mobile or area sources. Purpose is not to reduce emissions, but to give RACT and NSR sources compliance flexibility. Shutdown credits can only be used by the generator or they revert to the state. |

# Appendix A:  State and Local Trading Programs

| State | Program Name | Implementing Agency | $NO_x$ | $SO_2$ | Other | Description | Sources | Status | Goal | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| New Jersey | Open Market Emissions Trading | New Jersey Department of Environmental Protection | X | | X | Authorizes trading of discrete emission reductions (DERs), equivalent to 1/20th of 1 ton of emission reductions from stationary or mobile sources. Phase I involved regulatory development; Phase II reviewed program. 10% discount is assessed at time of use. | Stationary Mobile | August 2, 1996 | Lower costs of compliance. | Generation and use periods for DERs cannot exceed one year. Only DERs generated during the ozone season can be used during the ozone season. |
| New York | NSR Emission Offset Program | New York State Department of Environmental Conservation | X | | X | Authorizes the creation, use and trading of ERCs. ERCs can be used by stationary sources for NSR netting as offsets only. | | | NAAQS Attainment | ERCs are rate-based units. Once certified and registered, ERCs are not discounted and have unlimited life. All types of emission reductions from stationary sources are allowable. Credit from mobile sources may be granted later. |
| Pennsylvania | Nitrogen Oxides Allowance Requirements | Pennsylvania Department of Environmental Protection | X | | | Mandatory cap-and-trade program for fossil units @ >15 MW and/or 250 MMBTU/hour in every ozone season. Each source receives allocations based on 1990 operations. | | November 1, 1997 | Compliance with OTC ambient air quality standard for ozone. | Sources may opt-in if they have a documented baseline and comply with all requirements, including emissions monitoring. Once opted-in, sources cannot opt-out. |
| Texas | Emissions Banking Program | Texas Natural Resources Conservation Commission | X | | X | ERC banking and trading program in the state's 4 ozone nonattainment areas. ERCs are used as offsets for NSR. | Stationary | | Ozone attainment/ Economic development | ERCs can be used for NSR only. ERCs are certified by TNRCC before sale. ERCs can only be used in the nonattainment area in which they were generated. |

# Appendix A:  State and Local Trading Programs

| State | Program Name (Local Programs) | Implementing Agency | $NO_x$ | $SO_2$ | Other | Description | Sources | Status | Goal | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| California | New Source Review | San Diego Air Pollution Control District | X | X | X | Requires emission offset for any potential increase from a new major source or existing source undergoing major modification. | Stationary | July 5, 1979 | | |
| California | Project SEED (Solutions for the Environment and Economic Development) | Sacramento Metropolitan Air Quality Management District | X | | X | Pilot program: SMAQMD leases ERCs to stationary sources at the equivalent open market price. | Stationary Mobile | September 4, 1996 | | |
| California | Regulation XX--Regional Clean Air Incentives Market (RECLAIM) | South Coast Air Quality Management District | X | X | | Mandatory cap-and-trade or allocation program for stationary sources emitting 4 tons/year or more of NOx or SOx. | Stationary | October 15, 1993 | Emissions reduction | Some facilities (restaurants, police facilities, etc.) are categorically excluded from RECLAIM. Other categories (including hospitals, ski resorts and more) can opt-in. At the end of the second compliance year, 330 facilities participated in the NOx market; 37 also participated in the SO2 market. Participation is from stationary sources, but ERCs from mobile sources can be converted to RTCs. |
| Texas | Area Emission Reduction Credit Organizations (AERCOs) | Local governments, as directed by Texas State Legislature statute | X | | X | AERCOs assist sources subject to NSR wanting to locate in ozone nonattainment areas to locate offsets (ERCs). | Stationary | March 1, 1994 | Economic development | AERCOs can receive ERCs as donations, can acquire them, or can receive money to purchase ERCs. |

# Appendix B: Legal Prerequisites

## Table B.1 Summary of Legal Prerequisites for Emissions Trading Programs

| **Criterion** | *Discussion* |
|---|---|
| Defined private property right that establishes a non-revocable entitlement to emit | In order for a market to exist the program must create an entitlement that is non-revocable outside predefined circumstances. Defining the right is necessary both to protect the investment of the person who generates the right and to assure the person who purchases the right as to its viability. There must be assurance that the rights obtained by the emissions reductions are defined and free from significant change. Without a clearly defined right held exclusively by a private interest, no trading can reasonably occur. |
| Entitlement can be conveyed through a purchase or trade | Commercial laws have to be applicable and unambiguous with respect to rights and liabilities of the parties to the transfer. |
| Method for distributing rights | Two types of distributions are possible:<br>-credit programs award emission rights for excess reductions. In EPA's Final Emissions Trading Policy, for example, emission reduction credits were granted for emissions reductions that are surplus, enforceable, permanent and quantifiable.<br>-allowance programs distribute emission rights in advance. |
| Rights are the exclusive means of offsetting actual emissions | Without a prohibition non-trading alternatives would compete against trading as a means of meeting emission reduction requirements. In addition, any emissions trading program must be accompanied by a general prohibition on emissions except in accordance with the rules. This is required in order to give the rights created a value. No waivers, no exceptions, no excuses. |
| Entitlements must have characteristics of a commodity | Rights must be standardized so that each one has the same value as any other. Assets that are currently traded as commodities have an elaborate system of standardization to assure the fungibility upon which the system depends. |
| Internally consistent system of law that provides for individuals and organizations to hold and transact intangible assets and the rights and liabilities of all parties. | Entitlement that can be conveyed through purchase or trade |
| Method in which the rights can be used by their ultimate consumers in exchange for actual emissions, including tracking for rights trading and for monitoring emissions, as well as regular reconciliation. | This includes tracking systems both for rights trading and for monitoring emissions, as well as a means of reconciling the two at regular intervals. The ideal for an emissions trading market is to set out the accounting methods and rules in advance. That is unlikely to succeed immediately in a new program; all of the programs tried so far have encountered unanticipated accounting problems, some causing delays, others causing increases in violation. At a minimum, there should be a requirement for parties to maintain their own records and audit them for quality assurance at regular intervals. |
| Decision rules to use in resolving disputes and determining violation, and in case of dispute of assigning liability. | The decision rules have to be considered and established in advance so that the market can properly assess risks. |
| Absence of prohibitions or other barriers that prevent or diminish the value of participation in it. | As apparent as this might be, trading programs have frequently encountered such barriers. |

Source: Alan Loeb, Esq., *Legal and Administrative Predicates for Emissions Trading: A Case Study in the Amenability of the Chinese Legal System*, presented at Market Approaches to Environmental Protection Workshop, May15-June 2, 2000, Washington D.C.

## Table B.2 Summary of Administrative Prerequisites for Emissions Trading Program

| Criterion | Discussion |
|---|---|
| Technical system of standardized measurement for emission monitoring, data compilation, reconciliation, review, and violation detection | Produce consistent, high quality data on actual emissions for all parties; an accounting system must be complete and consistent; emission rights should be treated as a commodity and given characteristics as a fungible asset, which requires greater accountability than has been acceptable under command-and-control |
| Duplicate data sets | Evaluation of program effectiveness should not rely entirely on a single data set reported by regulated parties to show compliance, and data generated by a party may be used for trading only if they can be independently validated |
| Strict enforcement for violations | Effective and rapid enforcement is essential to a functioning market; if violations are allowed the market and the program will quickly fail; audits are desirable, and changes in penalty structure are essential to send appropriate price signals. |
| Dispute resolution | Policies and a dispute resolution mechanism must be in place to reconcile conflicting claims by parties to rights to emit |
| Consideration of additional administrative costs | Given the additional administrative costs of trading, a trading program is worthwhile only if the efficiency savings from trading exceed its costs |

Source: Alan Loeb, Esq., *Legal and Administrative Predicates for Emissions Trading: A Case Study in the Amenability of the Chinese Legal System*, presented at Market Approaches to Environmental Protection Workshop, May15-June 2, 2000, Washington D.C.

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