Emissions Trading Education Initiative

Emissions Trading Handbook

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Chapter I. Introduction

At the heart of the cap and trade approach to emissions trading is a focus on environmental performance rather than on technological compliance. This shift in focus protects the environment while allowing regulated sources to determine the best means of compliance in the context of other decisions facing each source. This flexibility enables regulated sources to minimize the cost of pollution control and also provides incentives to develop innovative and cost effective substitutes and pollution control strategies. Although cap and trade is not appropriate in all settings, it has been used successfully in past programs and may be applicable to address future pollution problems.

How We Got Here

In the nearly 30 years since EPA has been regulating air pollution, ground level ozone (smog) and its precursor nitrogen oxides have proven to be some of the most difficult control challenges. Regulation of these two pollutants in the U.S. has evolved over time with changes in the economy, our scientific understanding, and technology.

Early pollution control programs often required sources to install a specific technology or to achieve specific emission rates, concentrations or percent reductions at all facilities. The overall goal of the Clean Air Act was to protect public health. And, the regulatory approach was to pick levels of control that were fair – both in term of the amount of pollution they would remove and the individual cost that would be born by sources. That said, regulations typically contained provisions to exempt specific sources if it was found that compliance would be too costly or physically impossible.

The problem with this approach was that as the economy grew, the total number of sources and the total number of hours of operation increased. As a result, regulations could not keep up with increasing levels of pollution, and air quality deteriorated.

Regulations continued to limit the flexibility of sources to emit. Rules required that sources install certain technologies or meet even lower emission rates. In certain cases, the regulations required that no additional sources be placed in areas where air quality had become unhealthful. But even this was not enough to control pollution.

One problem with the approach was that it implicitly allocated a scarce resource – the ability to emit pollutants – to the first taker rather than according to a strategy which accounted for the value of that resource. As cities and towns grew they began to find that they could not afford, from an air quality perspective, to allow new sources to locate within their borders, nor could they allow existing sources to expand. It was determined that this situation was untenable and regulations needed to change to increase flexibility.

The first steps to this increased flexibility came in the form of “bubbles” and “offsets”. *Bubbles* are a type of compliance mechanism, which allows a regulated facility with multiple sources to combine their total emissions targets for the facility under a “bubble”. Facility operators could apply pollution control technologies to whichever source under the bubble had the most cost-effective pollution control options, but the total amount of emissions under the “bubble” would have to be less than what would have been allowed if each source met the conventional requirement.

Bubbles allowed for the first form of emissions trading through intra-facility trading. Reductions and trades were negotiated with regulators on a case-by-case basis. While this cumbersome process was expensive, the system at least allowed for expansion at existing sources. New sources inside the bubble could be brought on line as long as the old sources reduced overall pollution amounts to compensate.

Offsets represent the next iteration of bubbles and have been used to account for new growth. Offsets are created when a source makes voluntary, permanent emissions reductions that are legally recognized by a regulator. Existing sources could trade offsets to new sources to cover growth or relocation as long as each trade was approved by regulators. These offsets were generally called emissions reduction credits or ERCs.

Although these early trading programs saved money and added flexibility, they were cumbersome to administer and had high transaction costs. The programs required the conversion of technology or emissions rate requirements into a tradable commodity, such as tons of a pollutant emitted. This required all parties (emissions credit generator, emissions credit receiver, and governmental authority) to negotiate and agree on a number of factors, including: baseline and future utilization rates for credit generating and receiving sources; the time over which the trade would be valid; and whether or not the reductions for credit would have happened but for the trade. Moreover, all parties had to agree on how emissions at both sources would be quantified. Finally, it was also often necessary to ascertain that the air quality would not be worsened by the transaction.

This process could be resource intensive and time consuming with changes to the agreement often requiring renegotiation. The process created significant transaction costs and limited the number of trades (and later the creation of ERCs) to those circumstances where there were clear and substantial economic benefits. Despite the considerable efforts to ensure that transactions would not worsen the environment, most air regulators and environmentalists remained suspicious of emissions trading.

The 1990 Clean Air Act Amendments included a section devoted to ozone control and further clarified the role and opportunity for offsets and potentially for other emissions trading. As a result, states and other policy advocates have worked with EPA to develop programs that enhanced flexibility while retaining the basic structure of a command and control program.

At the same time that this evolution in command and control regulation was taking place, a separate market mechanism was developing for SO_2 allowances under a completely different regulatory framework – that of cap and trade. A separate section in the 1990 Clean Air Act Amendments created a cap and trade program to address SO_2 emissions, the precursor to acid rain. The success of this program has influenced the design of recent NO_x control programs for addressing ground level ozone. Today, there is one operating NO_x cap and trade program being operated in the Northeast states, and a second is planned for a broader set of Eastern States. This model is also being assessed for its applicability to other pollution problems.

Where Are We Today?

As the world economy continues to grow, pressures on our environment increase as well. Although cap and trade is not appropriate for all pollutants, well-designed and enforced programs have the potential to significantly help in addressing several of the major pollution problems we face today. Well-designed programs share at least four characteristics:

Cap and trade sets firm targets

The cap goes to the heart of the challenge to reduce air pollution. When we identify pollutants that harm the environment or threaten public health, a cap sets a firm and permanent limit, lowering the amount of these pollutants in our world. Caps set clear limits and quantifying the challenge for all participants.

Cap and trade recognizes value where it exists

When a power plant reduces pollution below an assigned limit, that reduction has value for the environment. Cap and trade under the U.S. Acid Rain Program creates a market for surplus allowances, thereby recognizing this value.

Cap and trade lets the marketplace work

In the U.S. Acid Rain Program, power plants were given clear limits, but the program rules gave plant operators the freedom to decide how to reach these limits. This set up competition between plants to develop the most cost-effective pollution reduction system (and also created competition among manufacturers of pollution reducing devices). A competitive marketplace stimulates innovation, rewards efficiency, and speeds the pace of development.

Cap and trade ensures fair play

Under the U.S. Acid Rain Program, plants must make quarterly reports to EPA detailing precise emissions totals. In the interest of full disclosure, the EPA posts this data on the Internet for public access and review.

About the ETEI Handbook

This Handbook serves as a tool for all potential practitioners in existing emissions trading markets and those which may arise in the future. Section II discusses the construct of the American system of cap and trade as applied in the U.S. program to reduce pollution of sulfur dioxides. Although still young, this emissions trading program has led to a perfect compliance record and environmental gains that exceed expectations.

Sections III and IV provide "how-to" information to get participants started. This information includes extensive explanations of how existing cap and trade programs function. These sections also contain information on how the market is constructed and what types of risk management tools are available. The reader will find that the discussion about market construct, transaction structures, and portfolio risk management is applicable for any commodity. That is because a well-designed cap and trade program can transform an environmental management program into a commodity market without losing sight of the goal: protecting the environment and human health.

Finally, the last section gives the reader an overview of other programs that employ the basic cap and trade framework and are being designed to address the environmental hazards of smog and ground level ozone. These programs are just underway, but regulators and industry have hopes that the successes of the Acid Rain Program's cap and trade system can be achieved in these programs, as well.

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Chapter II. Cap and Trade in Action

(A.) The U.S. Acid Rain Program: A Case Study on the Use of Cap and Trade

The Problem:

In the late 1970's public attention became increasingly focused on the potential environmental damage being sustained by the Eastern United States from acid rain. To address this issue, the U.S. Congress invested over $570 million in a 10-year scientific study known as the National Acid Precipitation Assessment Program or NAPAP.

Scientists identified the cause of the continuing environmental damage as air pollutants arising from power plants and industrial facilities. *Sulfur dioxides* (SO_2) and *nitrogen oxides* (NOx), were undergoing a chemical reaction in the atmosphere when combined with moisture. The reaction involving SO_2 forms a destructive dilute sulfuric acid, which became known as "*acid rain.*" The primary source of SO_2 and NO_x are large plants that burn fossil fuels to produce energy, although there are other significant sources as well.

The Program:

Congress, in agreement with the NAPAP study, decided that a 50% reduction in SO_2 emissions from power plants and a significant reduction in NO_x emissions from power plants were necessary first steps to address the acid rain problem. The resulting *1990 Clean Air Act Amendments* created the *U.S. Acid Rain Program*, which made a wholesale change in the way SO_2 emissions were regulated. Rather than relying on command-and-control, it set a strict emissions cap for power plants and, in return, provided them with unprecedented flexibility in determining how to meet that cap.

The Acid Rain Program set the cap at 8.95 million tons of SO_2 per year. The program is implemented in two phases. In Phase I, which began in January 1995, the largest, highest emitting electric utility generating units were required to reduce emissions. In Phase II, which will begin in 2000, virtually all electric utility units will be required to reduce their emissions to roughly one-half of 1980 levels or the 8.95 million ton cap. Under the program, sources are required to hold allowances equal to each year's emissions. Participants are free to choose how they want to comply, but at the end of each year they have to surrender enough allowances to EPA to cover their actual emissions. Failure to comply with this provision results in automatic penalties, which are enforced by EPA.

An effective tool for harnessing the power of the open market was found in a cap and trade system. It is viewed by many as a model for other environmental programs. Under the Acid Rain Program, the "cap" was firmly set and reduced emissions to levels that were roughly half of those in 1980. Looked at another way, the cap reduced the level of SO_2 emissions utilities were *allowed* to emit by 50%.

The cap was denominated in *allowances*, which were provided to all affected sources. Strictly speaking, an allowance authorizes a unit within a utility to emit one ton of SO_2 during a given year. Allowances are standardized and issued by *vintage years*, or the first year in which the allowance can be surrendered to the EPA to cover a source's actual emissions for that year. Allowances are also bankable, meaning unused allowances can be used in future years. Most importantly, allowances are tradable, and any individual can open an account to buy or sell them. These attributes make allowances both an asset and a rationed commodity, empowering the involvement of financial markets.

Although at its core the SO_2 market is a part of a regulatory program, it has many attributes of a financial market as well. For example, market institutions such as brokerage houses and law firms specializing in contracts have emerged with the market. Allowances are transferred and traded among parties, creating an efficient market mechanism.

Utilities can chose among a host of options with which to reduce their emissions, including switching from high-sulfur fuels (primarily coal) to lower sulfur fuels (low-sulfur coal or natural gas) or installing pollution control equipment. Trading allows the market to redistribute the rights to emit SO_2, thereby determining a more efficient and economic source of reductions.

Sources are required to execute allowance transactions through the EPA's allowance tracking system (ATS). The ATS allows the public to review all transactions as well as the accounts of all market participants. Improvements in the ATS have also allowed the EPA to reduce the time and cost of completing transactions to minutes.

At the end of each year, each unit must hold a number of allowances at least equal to its actual annual emissions. Utilities not in compliance face severe penalties and find no reprieve from their responsibilities to reduce overall emissions. The penalties include a $2,000 per ton fine adjusted for inflation. And, the offending source must supply offsetting allowances in the next year through reduced allocations or an emission reduction proposal submitted to EPA.

The Results:

Since the program began in 1995, there has been 100% compliance with SO_2 requirements. The incentives created by banking opportunities have led the sector as a whole to reduce and bank roughly 30% more emissions reductions through 1998 than was required under law. Market observers project banked emissions reductions will reach between 10 and 11 million tons by the year 2000.

Just as importantly, the cost of protecting the environment through the U.S. Acid Rain Program has fallen softer on the economy than originally anticipated. The economic efficiencies gained through compliance flexibility and the trading and banking provisions are thought to be primarily responsible for these cost savings. Reductions were projected to cost utilities between $4 billion and $8 billion annually when the program was fully implemented in 2010. However, more recent projections indicate that the program will cost around $1 billion annually when it is fully implemented.

For more information check these Web addresses:
http://www.epa.gov/acidrain/overview
http://www.epa.gov/acidrain/lawsregs

Acid Rain By The Numbers

8.95 million tons:
number of allowances allocated annually in Phase II

100%:
compliance since beginning of U. S. Acid Rain Program

10-11 million tons:
projected tons of allowances banked beyond required levels during Phase I

$4-$8 billion:
projected cost of reductions before Clean Air Act Amendments

$1 billion:
revised projected cost of reductions after U. S. Acid Rain Program

25 million tons:
allowances transferred in ATS between economically distinct organizations from 1994 through 1998

1 million:
spot trades in 1998

1.3 million:
option trades in 1998

(B.) Acid Rain Success Story: Wisconsin Electric Plays the Market

The on-the-ground experience of one large Midwestern utility provides an example of how the cap and trade mechanics of the U.S. Acid Rain Program work. Wisconsin Electric Power Company (WE), a subsidiary of Milwaukee-based Wisconsin Energy Corporation, has used the cap and trade program to reduce emissions of SO_2 and still produce low-cost power, providing both economic and environmental benefits for its customers and the community.

> *"Under a cap and trade, a mid-sized company in Milwaukee, WI has reduced emissions by more than 160,000 tons over and above our requirements. I don't think that would have happened without cap and trade."*
>
> *"With cap and trade, you can make a significant difference on the environment, and it won't cost your shareholders a significant amount of money, won't cost your employees jobs, won't impinge on unsustainable economic growth — but it will still provide benefit to the environment. This is a win-win situation."*
>
> Richard A. Abdoo, chairman and CEO of Wisconsin Electric

At the outset, WE devoted considerable resources to compliance planning. In the early 1990s, the company ran scores of scenarios looking at projected power sales and power plant usage well into the future. Computer programs estimated how much the utility would run each of its affected units and then calculated the resulting emissions of SO_2 and NO_x. These projections were then compared to their allocations under the U.S. Acid Rain Program.

After running the initial numbers in 1994, WE found themselves with 200,000 to 250,000 excess allowances for the five years of Phase I compliance. Excess allowances came largely from pollution control measures the company had previously implemented. However, the company found itself short 30,000 allowances per year for Phase II compliance, starting in 2000.

Excess allowances for Phase I could be banked or sold into the emissions trading market. In addition, the utility had several options relating to meeting Phase II requirements. These included: switching to low-sulfur coal; installing pollution control technology at the plant site; making modifications in the way they dispatched various electric generating units; and entering the market to purchase allowances. After comparing options, WE found fuel switching to be the most economic choice and one that would have the smallest impact upon its customers' power bills. It was estimated that fuel switching would reduce roughly 10,000 to 20,000 tons of SO_2 emissions. Taking all this into account, WE determined that the most cost-effective strategy would be to sell the excess Phase I allowances and purchase additional Phase II allowances, as required.

WE testimony in July 1997 before the Joint Economic Committee of the U.S. Congress stated that making up the shortfall through alternative means, such as the installation of scrubbers on at least two units, would have been too expensive. By choosing a route combining fuel switching and strategic allowance sales and purchases, the company estimated that it saved $100 million.

With over 200,000 excess Phase I allowances for sale and the decision to enter the market to make up its shortfall for Phase II, WE put in place a trading strategy. The company would sell its excess allowances over time while simultaneously buying allowances for Phase II. This technique applied the principles of *time weighting*, in which the company engages in a steady flow of smaller trades over an extended period of time. This approach takes away the highest and lowest prices, but seeks the best price on average.

Overall, the program has been very successful, and WE met 100% of its compliance targets in a cost-effective and efficient manner.

Chapter III. The Basics of Trading

The goal of ETEI and this Handbook is to provide you with the "how-to" background that will empower your participation in cap and trade systems. The next two sections of the Handbook will introduce you to the basic tools of the market, and also provide information on how to use some of the advanced structures that are available. This section discusses trading basics, using the U.S. Acid Rain Program as an example, and describes how to participate in an emissions trading market using the basic tools of that market. It includes a discussion on compliance planning, market construction, execution of a basic trade, and settlement. The next section begins to explain some of the more advanced risk management tools available for portfolio management, such as forward settlements, swaps, option, and hybrid structures. It then gives one company's example of entering the SO_2 market and transacting an emissions trade to demonstrate how some of these tools have been put to work in a real world situation.

(A.) Compliance Planning

Today, electric utilities have a host of pollution control options before them and choosing the mix of options that best fits from both an economic and environmental perspective can be a difficult task. A utility's planning process is complex and must factor in demand for power and the emissions associated with generating it. From there, the utility needs to assess its pollution control options, including participation in allowance trades.

These variables are influenced by a large number of factors, which give rise to an astounding range of permutations in compliance planning. However, breaking the decision process down into its core components, applying time-honored economic techniques, and using computer technology can assist in mapping a course for compliance. The experience of a few utilities can be helpful and their perspectives are provided below.

Long-Term Strategy

Because internal compliance planning brings together so many varying disciplines, many utilities have formed cross-functional teams which span the company in order to assemble the expertise necessary to make the best decisions on pollution control. For instance, Potomac Electric Power Company (Pepco) a major utility in the mid-Atlantic region, pulls individuals from the generation group, engineering and power marketing, business planning, fuel procurement, and environmental management and emissions trading operations to assist in compliance planning.

No matter how the compliance planning team is assembled, it is essential that the team set in place a comprehensive long-term strategy that spans several years, yet is flexible enough to be fine tuned on a weekly or even daily basis. Aside from making fundamental infrastructure decisions, emissions control is essentially a function of making changes to the way a utility generates power. Because power plants represent massive capital expenditures that can take up to 10 years to design, permit, and construct, a compliance plan needs to take a long view on how these resources will be used. For its part, Pepco operates with a ten-year compliance plan.

The long-range plan is compiled by the entire compliance planning team, including the emissions trading practitioner, who provides insight on market supply and demand for allowances. The trader adds value to the long-term compliance planning process by outlining emissions trading strategies that can assist in managing compliance cost risks.

Pepco
Clean Air
Steering Committee

Power Marketing
Fuel Procurement
Business Planning
Generation Operations
Environmental Consultant/
Emissions Trading Specialist

Source: Pepco

In addition to evaluating the effect of allowance trading markets, the compliance planning team will generate emissions projections based on an analysis of a number of factors that can affect demand for power generation. Demand factors that these teams tend to watch most closely include:

- **Projected Sales:** How much power does the utility expect to sell over the next several years?
- **Power Pool Requirements:** How much power does the utility have to hold in reserve, according to regulations of local power pools?
- **Long-term Position:** As utilities become more competitive, their demand profile can be under constant revision as they gain or lose major customers. What is the demand forecast and how will the utility dispatch electricity from its various units to maximize profits?

In addition to the *demand side* variables, compliance teams also keep an eye on the *supply side* as well. Utilities must determine which plants are in operation and with what source of fuel. For example, a utility that owns several generating plants, including a nuclear plant, may decide to increase generation at a fossil fuel plant while it shuts down its nuclear plant for refueling, resulting in more emissions.

Quantitative Analysis

After the team has developed inputs from the demand side and supply side, it can create base case scenarios (usually high/middle/low cases) that, in turn, can be used to develop emissions forecasts. Most often, the environmental compliance manager for the utility will coordinate this process. These scenarios provide the utility with a basis against which to compare its actual emissions performance throughout the compliance period. The utility can also compare its expected and actual emissions with its allowance holdings to determine its position prior to EPA's compliance review. Also, with new emissions regulations possibly on the horizon, the projections may include CO_2, other greenhouse gases, and other pollutants, in addition to the SO_2 and NO_x emissions covered in the Clean Air Act.

In comparing expected emissions with the allowances it holds, a utility may find that it faces one of two situations: the utility may hold fewer allowances than its expected emissions making it *short* on allowances; or the utility may hold more allowances than its expected emissions, making it *long* on allowances. Whether a utility's position is short or long will determine its actions in the market as it develops future strategies to address the situation.

Emissions Reduction Measures

If the utility is in a long position it may "bank" the allowance surplus or it may sell or trade excess allowances in the emissions market. The emissions trading practitioner will be instrumental in this decision, providing emissions trading market data on allowance availability and prices.

If the utility is in a short position, it has to decide whether to cut emissions in the coming months to bring them in line with allowance holdings or to purchase allowances in the market. Again, the cross-functional team will analyze base case scenarios–using sensitivity analysis to explore the emissions performance and costs associated with various pollution control options. The emissions trading practitioner plays an important role in this process.

The emissions trading practitioner informs the compliance planning team of the current trading prospects and prices in the marketplace, as well as supply and demand trends for allowances. The team then compares these figures, which are compiled from a variety of market sources including published indexes and figures quoted by other market participants, with the other strategies available in the compliance plan. In the current SO_2 market there are several emission reduction strategies available:

Fuel Choice: This is probably the most often used pollution control mechanism. Utilities can switch from high-sulfur fuels to low-sulfur fuels, such as low-sulfur coal and natural gas, and sometimes achieve dramatic reductions in SO_2 emissions. Furthermore, with improved access to low-sulfur coal supplies in the West, this has become an attractive and economic option for many utilities.

Purchased Power/Power Markets: There are cases where utilities can purchase power to supply its customer base that is cleaner than its own power.[1] The sources from which the utility purchases power will, however, have to have allowances to cover any emissions that would result from this generation. Therefore, the integrity of the cap will be preserved.

Electric Power Dispatch: The U.S. Acid Rain Program provides strong incentives for electric utilities to factor the environmental "cost" of SO_2 emissions control into the economics of running each generating station. This "cost" of SO_2 emissions is sometimes referred to as the "Environmental Dispatch Adder." Conceptually, by adding this SO_2 "cost" to the dispatch equation, it accomplishes two things. One, it sends the right signal for the lower emitting units to run first, assuming all other things being equal. Secondly, it attempts to reflect the "true" cost of generation by

[1] Units regulated under Phase I of the Acid Rain Program are subject to rules regarding utilization. Check the EPA Web site (**www.epa.gov/acidrain**) for more details.

reflecting the cost of environmental compliance in the price of energy that is sold into the market. Hence, environmental dispatch should send the proper signal to reach optimization at the lowest emission level and at the lowest overall cost the customers.

Pollution Control Technology: This is perhaps the most direct, and most expensive, method of controlling emissions. Certain technologies can be applied to a unit in order to clean up emissions as the pollutants move through the smoke stack. However, most pollution control device decisions are long-term and rather large capital investments. Therefore, they afford little flexibility to adapt to changes in short-term market conditions.

Emissions Trading: The Handbook will get more into the specifics of this market mechanism later, but it has become a key element in the compliance process. An open and transparent trading program provides utilities with valuable price information by which to judge other internal control measures. The program has enabled the market to find the most economic pollution control measures – ones that might not be found inside a utility's own system. Utilities employ trading in a variety of ways to ensure compliance and manage compliance costs.

The compliance planning team assesses each option on a cost per allowance basis, which will assist in determining the long-term course of action for the utility. The ultimate long-term strategy will likely seek to achieve the necessary emissions reductions as cost-effectively as possible, implementing first those options that are operationally feasible and least costly. The final plan could include a combination of the above reduction measures and will take into account other business factors affecting the utility.

Short-Term Refinements

With the long-range plan as an operating template, utilities turn their attention to short-term market factors that change constantly and, ultimately, can affect the

Compliance Planning Computer Programs

Pepco

Predictive Real Time Emissions and Allowance Compliance Tool (PREACT)

An internally developed model which forecasts emissions and optimizes net profits while managing compliance. The model allows multiple simulations of various compliance options, based on real time emissions data, sales and load forecasts, and generating parameters. The model computes economics and viability of various compliance options for immediate decision-making.

WEPCO

Clean Air Technology (CAT) Workstation

PC-based linear mixed-integer optimization model; capable of looking at time periods of 20 years or more; assists in determining least-cost compliance scenarios.

The Southern Companies

Allowance Tracking Workstation (ATW)

Developed to track allowances and print year-end reports for EPA.

Source: Pepco, WEPCO, The Southern Companies level of plant emissions. Many utilities, such as Southern Company, one of the nation's largest, develop emissions projections but convene cross-functional teams on a weekly basis to revise assumptions and monitor progress.

Utilities continually revise their demand projections by adjusting for increases or decreases in power sales, changes to power pool requirements, and changes to their to long-term position. Also, demand projection adjustments must be made to account for changing weather patterns. One of the single greatest factors affecting the demand side for utilities continues to be the weather, and compliance planning teams are constantly assessing weather conditions for the upcoming season (or the next week) for its affect on demand for power.

Meeting as frequently as weekly, compliance planning teams create quantitative analyses of these demand and supply factors and develop base case scenarios for emissions. These scenarios are then compared to initial projections in the long-term plan. As needed, the teams will again run sensitivity analyses on various emissions reductions strategies to guide short-term actions for compliance.

Keep An Eye On The Bottom Line

This type of planning activity is akin to treating pollution control as an input to power production. Finding the lowest cost emissions reduction solution is vital, and analyzing the costs and benefits of various compliance measures has a distinct reward component. Most utilities have computer programs developed internally to assist in running demand and supply forecasts. These programs can evaluate individual options as well as combinations of pollution control measures. Some also can track emissions records and automatically produce the reports required by the EPA under the U.S. Acid Rain Program.

No matter how sophisticated these programs are, their basis is always grounded in simple economic theory. Cost curves, a basic economic tool, can aid in determining the compliance decision for an individual unit. The concepts behind cost curves are explained below.

Cost Curve

The cost curve is a fundamental economic tool. The curve is actually a simple "supply" curve, which illustrates the average cost to reach a given level of emission reduction. Illustrated in Figure 1, the horizontal axis represents the cumulative total tons of SO_2 removed for a particular compliance strategy. The vertical axis is the average cost of making a reduction, calculated as dollars per ton removed.

To explain how the average cost curve works, we will consider a hypothetical utility that has three sources that emit SO_2. For this example, each of the three sources has the potential to switch to lower sulfur coal, switch to natural gas or install a wet scrubber to control SO_2. The cost to switch to low sulfur coal is assumed for illustrative purposes to be $100 per ton, to switch to natural gas is assumed to be $250 per ton and to scrub is assumed to be $500 per ton. These costs are for illustrative purposes only. Actual costs of control can vary from source to source based on the specific configuration of a plant, the availability of fuel choices and many other factors beyond the scope of this handbook.

Given these constraints, Point A on the curve in Figure 1 illustrates that 5,000 tons of SO_2 reductions can be achieved for a cost of approximately $100 per ton. This strategy involves switching source 1 to low sulfur coal, and doing nothing at sources 2 and 3.

Point B achieves a cumulative reduction of 10,000 tons of SO_2 reductions and involves a strategy where source 1 is switched to lower sulfur coal, source 2 is switched to natural gas, and nothing is done at source 3. The average cost of achieving the 10,000 tons of reduction under Point B is $150 per ton.

At Point C, to achieve a total of 30,000 tons of reduction source 1 is switched to low sulfur coal, source 2 is switched to natural gas and source 3 is scrubbed. A total of 30,000 tons of reductions are achieved at an average cost of $300 per ton. This information is summarized in Table 1 below.

Figure 1 - Basic Supply Curve

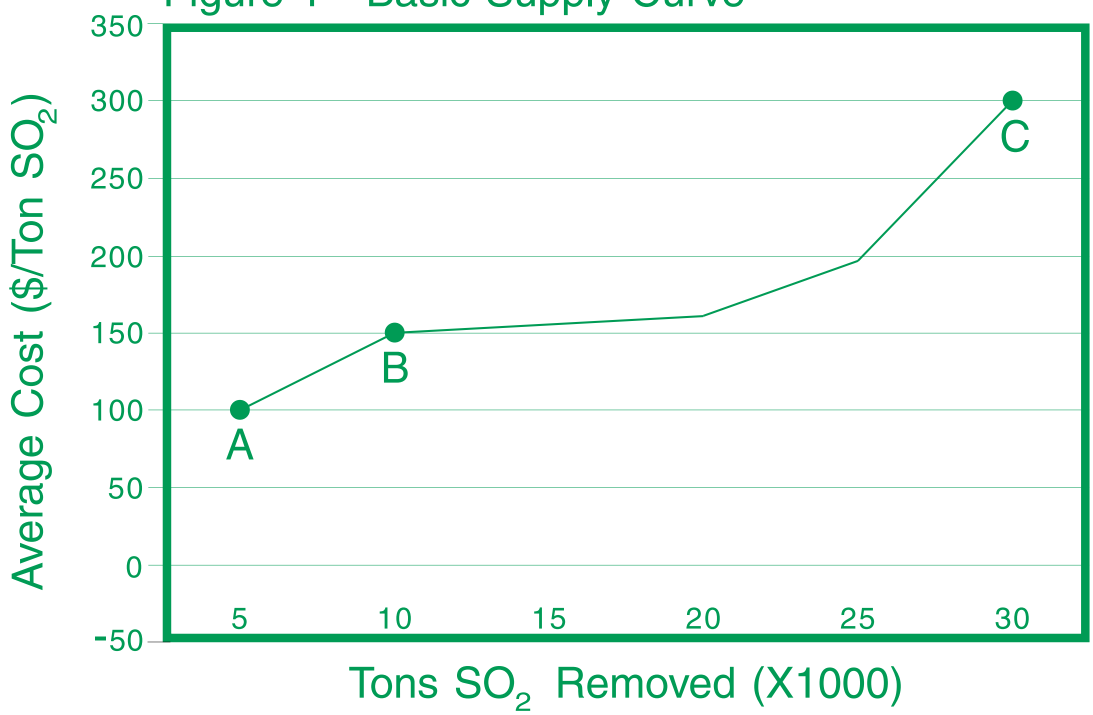


Table 1

Strategy A	Control Measure	Tons Removed	Cost per ton of control measure	Total Cost (Cost per ton x tons removed)
Source 1	Low sulfur coal	5,000	$100	$500,000
Source 2	None	0	0	0
Source 3	None	0	0	0
	Total Tons removed for Strategy A	5,000	Total Cost for Strategy A	$500,000
			Average cost for Strategy A	$100 per ton
Strategy B	**Control Measure**	**Tons Removed**	**Cost per ton of control measure**	**Total Cost (Cost per ton x tons removed)**
Source 1	Low sulfur coal	5,000	$100	$500,000
Source 2	Switch to natural gas	5,000	$200	$1,000,000
Source 3	None	0	0	0
	Total Tons removed for Strategy B	10,000	Total Cost for Strategy B	$1,500,000
			Average cost for Strategy B	$150 per ton
Strategy C	**Control Measure**	**Tons Removed**	**Cost per ton of control measure**	**Total Cost (Cost per ton x tons removed)**
Source 1	Low sulfur coal	5,000	$100	$500,000
Source 2	Switch to natural gas	5,000	$200	$1,000,000
Source 3	Scrubbing	20,000	$375	$7,500,000
	Total Tons removed for Strategy C	30,000	Total Cost for Strategy C	$9,000,000
			Average cost for Strategy C	$300 per ton

Next, factor in the allowance market. Figure 2 overlays a hypothetical cost of allowances at $175 per ton. Using the supply curve as a guide, a utility can make decisions on what course of action to take.

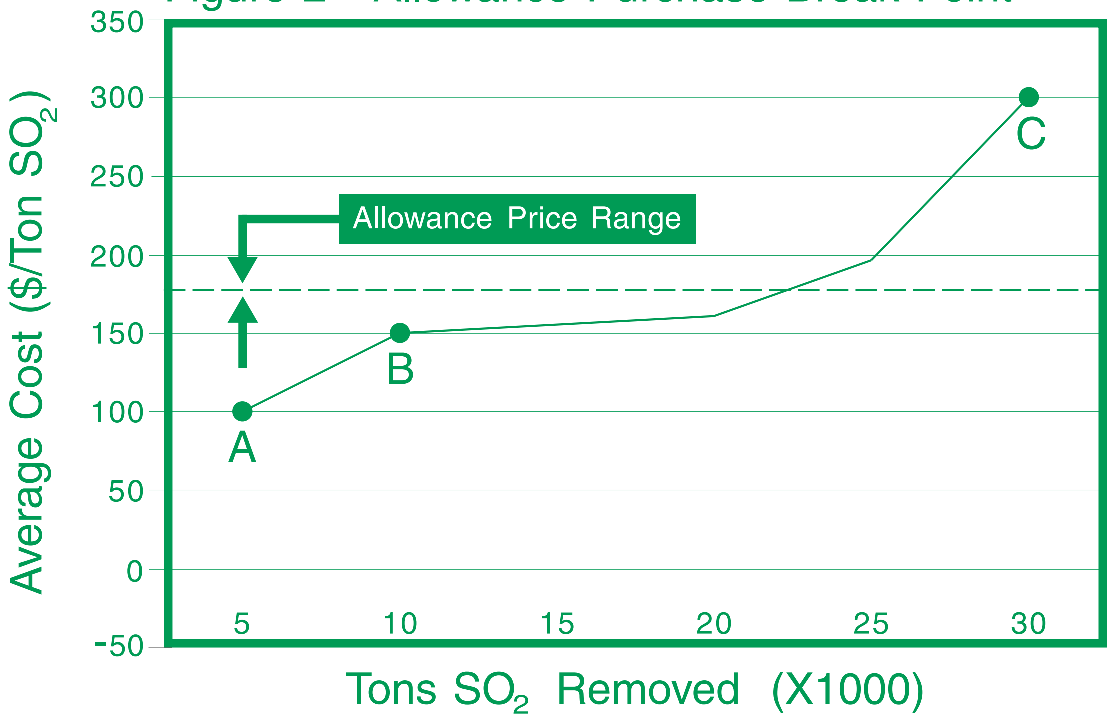
If the goal is to achieve 30,000 tons of cumulative reduction, we can see that Point C is well above the market price for allowances. Strategy C would not be the least cost option for compliance and would not be pursued based on economic reasons.

You would then look to Strategy B. While this option achieves 10,000 tons of reduction at an average cost of reduction of $150 per ton, we note that the component of this strategy that switches source 2 to natural gas has a cost of $200 per ton. This cost, called the "marginal control cost", is greater than the cost of allowances on the open market. So while Strategy B appears from an average cost perspective to be the least cost, it is not since the marginal cost of one of its components exceeds the cost of allowances in the market place.

The least cost strategy in this example is to implement Strategy A, and switch source 1 to low-sulfur coal achieving 5,000 tons of reduction at a cost of $100 per ton. To achieve the remainder of the required 30,000 ton reduction, 25,000 allowances should be purchased from the market at $175 per ton. The total cost to achieve this strategy is $162.50 per ton.

While a real utility system consists of many more plants with many more control options than this simple example the methodology remains the same. Planners construct average cost curves to help illustrate how compliance costs relate to cumulative reductions. However, before implementing any plan the marginal cost of the components of a given strategy must be investigated relative to the market price of allowances.

Figure 2 - Allowance Purchase Break Point



(B.) Market Construct

Having assessed compliance needs and weighed options in the marketplace; the next step is to prepare for entrance into the emissions trading markets. This begins by establishing an account. The U.S. Acid Rain Program requires that participants register with the EPA in its *Allowance Tracking System (ATS)*. The ATS is administered by the EPA Acid Rain Division and is the official record of emission allowances transactions and account balances.

As mentioned earlier, an important feature of the U.S. Acid Rain Program's emissions trading system is the availability of complete, transparent information on the allowances being traded. The ability for all market participants, and, indeed, the general public, to track the movement of allowances is vital to the program's success. At the center of this effort is the ATS, which is a database that holds the official record of all allowances as they change hands and, eventually, are *retired* or removed from the system.

The ATS assigns a unique serial number to each allowance. It is possible to track an individual allowance throughout its life from initial allocation, through each trade, all the way to retirement. The serial number consists of 12 numbers, the first four of which indicate the first year the allowance can be used for

EPA's Classification Methodology for Private Allowance Transfers Reported to ATS

Inter-Utility

- Any transfer of allowances from one utility operating company's account to a different utility operating company's account, provided the operating companies are not controlled by the same parent company. Both transferor and transferee accounts can be either general or unit accounts

Intra-Utility

- Any transfer from one unit account to another unit account within the same operating company.
- Any transfer from one operating company's unit account to another's unit account within the same parent company.
- Allowances transferred from the general account of one operating company to a unit account of the same operating company or parent company may also be intra-utility trades.

Reallocation

- Any transfer from a unit or general account of one operating company to a general account of the same operating company or parent company (some may become intra-utility in the future), any pooling activity (i.e. Phase I extension redistribution), or any transfer in which the transferor is a partial owner of the transferee account, or vice versa.
- Allowances transferred from the general account of one operating company to a unit account of the same operating company or parent company may also be reallocations.

Broker/Trader to Utility

- Any transfer from an allowance broker or trader to a utility.

Utility to Broker/Trader

- Any transfer from a utility to an allowance broker or trader.

Fuel Company to Utility

- Any transfer from a fuel supplier (i.e. coal, gas) to a utility.

Utility to Fuel Company

- Any transfer from a utility to a fuel supplier.

Other

- Any transfer that does not fit into any of the above categories. This includes transfers involving environmental groups, non-utility accounts, or individuals. Also included are broker to broker transfers, fuel supplier to broker transfers, etc.

compliance purposes – in other words its vintage year. For instance, allowance 2000-01234567 is a vintage year 2000 allowance and cannot be included by a utility in its year-end compliance report until the year 2000. Allowances not used in their vintage year can be banked or saved for use in future years.

Transactions involving allowances are tracked and categorized by the EPA. The agency collects information about the buyer and seller and the serial numbers of the transacted allowances. EPA does not, however, record the allowance price, instead deferring to the market, which can more efficiently process this information. Also, because companies are not required to report allowance transfers to EPA until the allowances are used for compliance, many transactions have not yet been recorded in ATS even though the private agreements are in place. EPA also does not track option trades and other transactions that have not been reported to EPA.

The ATS has two types of accounts: *unit accounts* and *general accounts*. The unit account holds allowances that were initially issued to those sources required to participate in the program. In addition, unit accounts track allowances as they are traded, withdrawn for compliance purposes, and ultimately retired for compliance.

General accounts are much like unit accounts in which trades are tracked. However, EPA does not adjust these accounts during annual compliance period reconciliation. These accounts can be opened free of charge by anyone wishing to participate in emissions trading—including sources that already have unit accounts. The allowances in general accounts are not subject to allowance deductions to cover actual emissions and can be held indefinitely.

Traders, environmental groups, citizens and other entities operate through general accounts in the ATS. General accounts are opened by submitting an Allowance Account Information form to the EPA. Once the agency has received this form, it will send confirmation of the new account, and the applicant is ready to trade.

Over-the-counter Market

One of the basic markets for emissions allowance trading is the *over-the-counter* market. Over-the-counter trading directly matches buyers and sellers, rather than moving trades through a centralized system. By contrast, trades for exchange-listed stocks are done through specialists that ensure the efficient movement of each listing. Emissions trading markets move with the participation of buyers, sellers, brokers, market makers, and traders—each using a direct link to purchase or sell allowances.

The prices for buying or selling emissions are fluid and determined with each individual trade. Because of the over-the-counter format, there is no central recording structure for current allowance bids and asks. Price information is readily available from market sources, such as brokers, traders, and indexes published by trade journals.

The buyers and sellers in emissions trading are individuals, organizations, or corporations that have a position in the market. Their motivations vary. Some trade to achieve regulatory compliance, others to retire allowances, or still others simply to turn a profit. Each buyer and seller has a publicly identified representative. This allows the buyer or seller to do due diligence and ensure its trade is legitimate.

There are three ways to participate in the over-the-counter emissions trading market, including bilateral transactions, trades transacted through a broker, and allowances purchases in the annual allowance auction.

Bilateral Trades

The direct point of entry into over-the-counter emissions trading markets is by contacting participants directly and arranging bilateral deals. There is no intermediary exchange for the emissions trading market, therefore all transactions are made on a direct, one-to-one basis. The ATS allowance account information found on the Internet enables participants to find other participants with whom to transact allowance trades.

This relationship-based approach, however, is usually employed by active market players who have extensive experience - and contacts - in the marketplace. Unless you possess this type of market presence, it is difficult to fully assess trading options without some assistance. One set of market participants that has this market presence are *Traders*. Traders are likely to be counterparties with the emissions trading practitioner in bilateral trades, but often their market profile differs from the practitioner.

Traders put their own money at risk in the market. Their motivation for participation in emissions markets is much like their motivation would be for entering stock markets or commodities markets: profit. Seldom do Traders make decisions based on the need for compliance.

Because Traders are willing to take positions in either direction of the market, they assist in generating liquidity. Their ability to generate a flow of deals makes some Traders "*market makers*", in which they play a role similar to that of a stock specialist on an equity exchange. Liquidity refers to a volume of trading in the market that allows buyers to find sellers at prices reasonable to both. Without sustained liquidity, the market would have improper pricing information discouraging any type of emissions trading practitioner from participating.

Traders operate under a long-term view that looks to profit from the market's movement— up or down. Traders profit from arbitrage opportunities by buying and selling allowances to capture the value between spreads. This can be executed, for example, through the simple standard of buying low and selling high, working the price spreads to turn a profit.

Brokers

Emissions trading practitioners not wishing to transact bilateral trades can enlist *brokers* as middlemen. Brokers do not take a position in the market, but rather facilitate transactions for *counterparties*. Just as importantly, brokers are a valuable source of market information, which market participants use to get an accurate sense of the current prices, as well as market volume. Another aspect of the broker's responsibility is to maintain the anonymity of counterparties. Being unknown to the marketplace gives a buyer or a seller the luxury to test the waters for a perspective transaction without tipping their identity or strategy. This element of confidentiality is vital when shopping for the best possible price. Only after the transaction is confirmed are the counterparties' identities revealed to each other.

The hands-on-role of the broker also enables it to engage in structured transactions, which can be more time consuming than a normal cash settlement or option transactions. Deals involving complex swaps of vintage years, cross-pollutant trading, or cross-commodity trading are likely to involve a broker who can provide expertise to the transaction as well as the manpower to shepherd a deal to completion. Brokers profit from the market through commissions charged on brokered transactions.

Annual Allowance Auction

At the creation of the U.S. Acid Rain Program, there was some uncertainty among lawmakers as to the future robustness of the emissions trading market and the availability of allowances for new sources of generation that were not in service during the baseline allocation period of 1985 through 1997. Of course, a case for an active trading market could be made on paper. But if the economics did not coalesce around allowance trading as anticipated, it was going to be tough to ascertain with certainty whether trading would be able to perform its pivotal role in compliance.

Therefore, the Clean Air Act Amendments set up an auction system designed to ensure a measure of allowance market liquidity and provide valuable price information. The auction is held annually on the last day of March and is run by the *Chicago Board of Trade*. To supply the auctions with allowances, EPA set aside a *Special Allowance Reserve* of approximately 2.8% of the total allowances allocated to all units. During Phase I, when the allocated allowances total 5.7 million allowances annually, 150,000 allowances are available each year for auctions. During Phase II, when allowance allocations total

8.95 million allowances annually, 250,000 allowances are earmarked annually for auctions.

The sale starts with the highest priced bid and continues until all allowances have been sold or the number of bids is exhausted. Credits purchased in the advance auction cannot be used until seven years after purchase. EPA may not set a minimum price for allowances used in the auction. The end results are posted by EPA on its Web site.

For more information check these Web addresses:
http://www.epa.gov/acidrain/atsdata2.html
http://www.cbot.com/
http://www.epa.gov/acidrain/auctions/aucmain.html

(C.) Execution

Having set forth a trading strategy and gathered information on market players, you are ready to execute trades. In fact, you are lucky: the rapid advancement of the SO_2 market has substantially shortened the learning curve for new participants. Just a few years into the program, there is a fully developed trading system, free-flowing market information, and healthy volume of transactions. Starting with the most basic of trades—a cash spot market transaction—this section explains the contracting issues you should be aware of as you close a deal and how to report the trade to regulatory authorities.

Spot Market Trades

Immediate settlement trades, or trades made in the spot market, are the most liquid type of transaction structure in emissions trading markets, accounting for approximately 75% of purchases and sales. Correspondingly, these transactions see daily bids and offers. *Bids* are firm commitments to purchase a specific quantity of allowances at a set price. *Offers* are the other side of the equation: firm commitments to sell a specific quantity of allowances at a specific price. Typical cash settlement bids and offers come in 5,000 to 10,000 allowance lot increments, however quantities as low as 1,000 allowances have been seen, and other than market practicalities, there is no floor to the size of deals.

Before entering the market, it makes sense to assess your needs and set your price parameters relative to the market. If you are short allowances and decide to turn to trading to make up the difference, the compliance planning you executed earlier should provide you with a "buy strategy" that will determine your transaction volume and the price at which you are comfortable buying. Conversely, if your position is long on allowances you will use your compliance planning scenarios to get a sense of how many allowances to offer in the market and at what minimum price you will sell.

Once you have determined your price targets, you are ready to trade. This can be done through a broker or executed bilaterally. No matter which direction you choose, the next step is to communicate your price to the marketplace. Individuals with standing bids and asks are approached first to determine their interest in a purchase or sale of allowances at your price. As interested participants counter with alternative prices, the market is made. From this point forward you can revise your price to move closer to the market and receive another counter bid or offer. This process continues until you have found a price in the market that satisfies your needs.

Having found a price that you are comfortable with, you are ready to lock in and seal the deal. The first step is to give a verbal confirmation or sign a *confirmation sheet*, which indicates your willingness to lock in the price and begin work on hammering out the contracting details. (Of note: this is also the point at which a broker will reveal the counterparties' identities to each other, should you have decided to go that route.)

Credit Risk

Contracting procedures for emissions trades are surprisingly standardized and simple. Liability concerns for emissions trades under the U.S. Acid Rain Program are low. Nonetheless, there are liabilities you should consider.

The emissions trading system dictates that, while allowances are granted by the government, there is no guarantee provided by regulators as to the ability of the seller to provide these credits. Therefore, the onus is on the buyer to determine the credit worthiness of the seller. Credit worthiness can be measured by credit rating agencies, such as Standard & Poor's, DCR, or Fitch IBCA. Often this is determined before choosing a counterparty for a bilateral trade, and an emissions trading practitioner working through a broker can stipulate that bids and asks should only be considered for counterparties meeting its pre-established credit criteria. In any case, *credit risk* is directly addressed in the contracting phase of the transaction.

Standard Contracts

In the SO_2 market, the contracting process is a relatively standard affair. In fact, the contracts used in almost all emissions trades these days bear a striking resemblance to each other. The Emissions Marketing Association (EMA) has even produced a sample contract which is just a few pages long, which can be downloaded from its Web site for use in transacting trades (www.emissions.org).

Despite the standard nature of the documentation, contracting parties must still keep an eye out for basic trading issues. Foremost is the ability of your counterparty to come through with their end of the deal, whether it be providing cash for your allowances or allowances for your cash.

In most cases, contracts will contain provisions protecting against the default of either counterparty. Their ability to pay is often measured by credit rating agencies. These independent assessments are often incorporated into the contracting process. Contracts commonly use protections, such as: setting up lines of credit (LOCs) to back the transaction; gathering guarantees from a counterparty's parent company; or securing recourse to the parent company.

Once the contract has been executed, it is time to let the allowances and the cash change hands. Typically the seller of allowances will deliver an *Allowance Transfer Form* (ATF) to the buyer. This is a standard EPA document that confirms the movement of allowances from one account to another. The buyer will then fill out the ATF and forward it to the

EPA, which will input the information in its tracking system. Cash or other payment for an immediate settlement transaction is usually made within three business days of an electronic or written confirmation by the EPA that the contracted allowances have been transferred in the ATS. EPA is moving toward electronic transactions rather than paper transactions.

With regard to the administration requirements for an allowance trading system, the Handbook has focused on the mechanics of opening allowance accounts and transferring allowances. These requirements apply to everyone participating in the market, not just the regulated industry. Of course, companies with compliance obligations under the U.S. Acid Rain Program are also responsible for filing other forms and reports with EPA. For more information on these requirements, see the Acid Rain web site at: **www.epa.gov/acidrain.**

For more information check these Web addresses:
http://www.standardpoor.com/
http://www.dcrco.com/
http://www.ibca.com/
http://www.emissions.org/

Chapter IV. Portfolio Management

(A.) Why Advanced Structures?

Until now we have primarily discussed one type of emissions trading transaction structure, the immediate settlement. As you might expect, this is just the beginning. Financial markets have been dealing in the trade of commodities for more than a century, and over that time increasingly complex vehicles have been developed. As structures gain market acceptance, they are often modified to create new ones, ever innovating to satisfy the demands of increasingly sophisticated market participants. The motivating factor behind the genesis of advanced structures in commodity markets is always to create new and better ways to manage risk.

Risk Management

Risk can come in many forms, but it almost always boils down to one issue: price. It is impossible to always accurately predict what the price of a commodity will be in the future, whether it is years or even months ahead. Therefore, financial markets have designed tools to enable market participants to lessen or *hedge* their risk that the price of a certain commodity will rise or fall. This also applies in managing and minimizing long-term compliance costs.

To take an example from emissions trading, consider a utility that projects it will be short on allowances in the year 2002. The company is determined to make up their shortfall in the trading market and sees that the going rate for 2002 allowances is $150. This utility has the risk that the price of 2002 allowances, which is holding at $150 today, may rise significantly in the future. This would increase the cost it must pay to purchase its allowances if it buys allowances in the future.

On the other hand, a utility holding an excess of allowances in 2002 confronts a risk directly opposing that of the previous example. If the utility is long on 2002 allowances, it certainly would not mind the price going up from $150. But, the utility is also hoping that the price will not fall and reduce the value of its allowance holdings. Although through the first half of 1999 SO_2 trading market has been relatively stable, it has demonstrated considerable volatility since its inception, making price risk very real.

Dollar Cost Averaging

All emissions market participants would have to agree that, although everyone has their own view of the direction of allowance prices, no one really knows for sure. In a sense, this puts even the most seasoned emissions marketing participant on an equal footing with the greenest emissions trader. What really sets the two apart is how they use the tools available in the marketplace to offset what they cannot accurately predict in price.

Since it is almost impossible to consistently buy at the bottom of the market and sell at the top, a strategy can be employed that averages out the highest of the highs and the lowest of the lows to produce consistent results. This strategy, known as dollar cost averaging, enables a utility to achieve consistent results by spreading out the buying or selling of allowances over a period of time. Doing so hedges the risk that prices will move aggressively against one by buying or selling in small increments at the current best available price. Under this strategy, the average price will be near to the annual average price.

Rise of Advanced Structures

These circumstances have given rise to the use of sophisticated structures, which have become commonplace in other commodities markets in emissions trading. Despite the fact that most emissions market participants are utility personnel more comfortable on a turbine floor than a trading floor, many have gotten over the initial learning curve and are starting to become active in the emissions market.

The rise of advanced structures can also be pegged to the growing experience of the average emissions trading participant. An increasing amount of the activity in the market today contributes to liquidity and hinges on financial plays. Most trades take place in order to ensure compliance, but an increasing number of transactions are structured to capture value in the market's movement much like the transactions in commodities markets.

(B.) Advanced Structures

Below we begin to outline some of the most widely used financial structures.

Forward Settlement

This type of transaction is much like the immediate settlement example discussed previously. The delivery of allowances and payment, however, happen some time in the future, as the name indicates. These types of transactions allow market participants to lock in future purchases at prices that meet their individual needs. It is also a sound tool for managing cash flow, as the buyer is able to book the definitive price of the future purchase well in advance.

Short-Term Forward, Long-Term Forward

The market has derived a few innovations to the forward settlement structure in order to satisfy varying needs. Buyers who are looking to lock in prices through a forward deal—but want to do so within a year—can transact a *short-term forward*. Usually, delivery and payment are scheduled for December, when utilities true up their emissions balance sheets.

The *long-term forward* typically extends settlement date by several years, and this type of settlement is contracted by adding on the seller's *cost of carry*. The cost of carry calculation essentially means the buyer will pay the seller a premium over the actual cost of the allowances in return for the delay in payment and delivery. In mature commodity markets, forward transactions are quoted prices much like spot transactions. However, the forward emissions market is too thin to have standing bids and asks, so a carry forward calculation is used instead.

Carry Forward Calculation Formula
[(current allowance price) x (allowance loan rate)] + current allowance price = forward contracting price

For example, if SO_2 vintage 2001 allowance prices are quoted at $100 dollars in July 1999, but a utility is interested in purchasing allowances for delivery in July 2001, the contract price would be $122.50.

i.e. [($100/allowance) x (7%)] + $100/allowance = $107.00/allowance *(compounded yearly for three years: $122.50)*

This premium reflects how the market prices future deliveries and payments, which usually incorporates the seller's cost of carry interest rate plus a premium assessed by the market to create a calculation known as the *allowance loan rate*. The market assumes prices will escalate between 6% to 8% every year, going out seven years. The rate is compounded yearly. In the above example, the rate used was 7%, but in reality this rate will reflect whatever the market will bear[2]. Therefore the difference in terms of cost to the seller of holding on to the vintage 2001 allowances for delivery in July 2001, rather than selling them immediately, is around $22.50 for each allowance. As the contract term extends past the year 2004, this cost decreases due to regulatory uncertainty.

Swaps

For settlement transactions (both immediate and forward) allowances are usually being exchanged for cash. This is the simplest form of allowance transfer and the most common in emissions trading markets. However, *swaps* have also become another popular type of transaction. At its most basic, swaps allow one party to exchange allowances of one vintage year for allowances of another vintage year from a second party.

Viewed in the context of compliance for the U.S. Acid Rain Program, swaps have the ability to use the market to efficiently distribute allowances. Take for example, utility A, which has plenty of SO_2 allowances for the year 2000, but is short 10,000 vintage 2002 allowances. On the other hand, utility B is short on vintage 2000 allowances yet is long by at least 10,000 allowances for the year 2002. Through a swap transaction, utility A could exchange its surplus vintage 2000 allowances for utility B's surplus 2002 allowances.

Immediate Vintage Year Swap

In the above example, we can assume the two utilities will transact this swap concurrently. Still, the swap generally would not be made on a one-for-one basis. If the transaction were done on a cash basis, the value of the vintage 2000 allowances would be higher than those vintages further out, reflecting the price differences in the market between earlier and later vintages. A ratio is used to calculate this difference, and it is usually given in terms of the earlier vintage and how it relates to the inherent value of the later vintage.

Vintage Year Swap Formula
{[ratio between vintage years x (later vintage year - earlier vintage year)] x amount of earlier vintage year allowances} + amount of earlier vintage year allowances = vintage year swap amount

For example, again, using the above illustration, utility A would give utility B 10,000 vintage 2000 allowances in return for 10,700 vintage 2002 allowances.

i.e. {[3.5% x (2002 – 2000)] x 10,000} + 10,000 = 10,700

[2] The ratios and interest rates provided in this chapter are illustrative of those found in emissions trading markets. However, actual ratios and rates are set by the market and change regularly. Market participants wishing to receive up-to-date information on ratios and rates should consult their emissions market information resources, such as published indexes or brokers.

The premium paid by utility B reflects a ratio of 3.5% per year between vintage years, which is calculated based on the cash differential between vintages and quoted in the marketplace.

Deferred/Delayed Swaps – or Loans

In cases where the counterparties do not wish to make the swap arrangement an immediate transaction, they can enter into a deferred or delayed swap transaction, placing a several month to several year lag into the equation. Although these types of deals are less common, they can be implemented to allow the parties flexibility in delivery times.

Counterparties can structure transactions in which one party delivers allowances the day the transaction is closed and the other transfers back allowances within 175 days. Despite this transaction taking on the form of a loan, the returned allowances often will be different from those originally transferred. This *deferred allowance swap* is specifically constructed to close within 180 days. Swaps that settle in less than 180 days are generally considered a nontaxable transaction.

These 175 day deferred swaps are what amount to a short-term loan of allowances, and like any loan, the borrower is charged an "interest" rate. The market ratio for this type of transaction currently is 0.75% to 1% every 175 days for vintage swaps of the same year. The ratio would increase as vintages differ.

Deferred or delayed swaps extending beyond 180 days are calculated slightly differently, and they actually take on an appearance much more akin to a *loan.* In this type of a transaction, one party loans allowances to another for a period of one to five years. The current "interest" or loan rate falls within the 1.5% to 2.0%-range per annum for quantities of 25,000 allowances or greater.

Deferred Swap Loan Rate Formula
[interest or loan rate x number of allowances] + number of allowances = 180 day deferred swap allowance amount

For example, if party A transfers 100,000 vintage year 2000 allowances it will receive 102,000 vintage 2002 allowances from party B one year later.

i.e. [2.0% x 100,000] + 100,000 = 102,000

The interest is compounded yearly. The extra 2,000 allowances provided by party B is the equivalent of loan interest. There is a specific credit risk associated by this transaction, and one that is born by the lender. The lender can certainly take measures to alleviate this risk, such as requiring the posting of security or establishing specific recourse positions.

The motivation for these types of transactions, of course, depends on the perspective of the parties. The borrower, most often, is trying to immediately cover a short-term need for allowances and is willing to trade later vintage years to cover their current year allowance needs for compliance purposes. On the other side, a utility with excess allowances may look to maximize the value of its portfolio of allowances with the interest accrued in a loan-type structure. Because trades are not submitted to the EPA's ATS until they are transacted, loans often do not appear in the system. It is up to the counterparties to keep track of the allowances owed or under obligation to another party. Delayed swaps or loans are becoming increasingly less common. In large part, the objective of these vehicles is easier—and some times more effectively—met with options.

Options

At their most basic, options are a means to hedge the risk of a rise or fall in price, but they can also be used to maximize revenue on a portfolio of allowances. *Options* provide the option buyer the right but not the obligation to buy a commodity (in this case, emissions allowances) at a specified price by a certain date. They can best be related to insurance policies in which an individual pays out a premium to the seller or "insurer." The insurer provides a "policy" to cover the buyer's risk of prices going up or down, depending on where the buyer sees their exposure.

Call Options: Rights and Obligations of Buyer and Seller

Buyer: The buyer is entitled to buy (or call) allowances at a predetermined strike price on the expiration date. This position might be taken by company that is short on allowances and wants to hedge the risk that prices will rise. Risk is limited to the amount paid for the premium.

Seller: The seller grants the right to purchase to the buyer, and collects a premium. The seller has the obligation to sell the allowances at a predetermined price, at the discretion of the call buyer. This position might be taken by a company that is long on allowances, is satisfied by the strike price, and is using a covered call option premium to maximize the value of their long inventory.

Call

Put into practice, options can be useful to a party that may need to buy allowances in the future and is hoping the price for these allowances will fall over time. Without options, the buyer faces a risk: If the price falls, they save money, but if the price actually rises they will have lost money by hesitating to purchase allowances earlier. The option used to manage this risk is known as a *call option*. To hedge the risk that prices will increase (known as the upside risk), the party can enter into an option transaction with a counterparty. The option allows the option buyer to buy allowances at a specific point in the future (the option *exercise date*) and at a specific price (the *strike price*). In return, the option buyer pays the option seller a *premium*.

As the exercise date approaches, the option buyer needs to decide how to act. If the market price for allowances is higher than the option strike price, the option buyer will exercise the option and buy the allowances for the strike price. If the market price for allowances is equal to or lower than the strike price, the option buyer will simply enter the market and purchase the allowances over-the-counter. In this case, the penalty associated with rising prices is limited to the premium paid by the option buyer.

Put Options: Rights and Obligations of the Buyer and Seller

Buyer: The buyer is entitled to sell (or put) allowances at a predetermined price on the date of expiration. This position might be taken by a company that is long on allowances in order to hedge the risk that the market price will drop (sometimes referred to as downside price risk). Risk is limited to the amount paid for the premium.

Seller: The put seller grants the put buyer the right to sell allowances and collects a premium. Note that under this arrangement the seller takes on the obligation to buy the allowances at a predetermined price at the discretion of the put buyer. This position might be taken by a company that is short on allowances, satisfied by the strike price and is using a covered put option premium to minimize their upside price risk for purchasing allowances.

Put

The contrast to the above example would be a situation where a party knows it has surplus allowances, but does not want to sell them right away. The party hopes that in the future the price for allowances will increase, allowing them to realize more profit from the sale than if they had sold immediately. The risk is that the market price for allowances will actually drop in the future. To hedge this risk, the party can purchase an option to sell its allowances at a given point in the future for an agreed upon price. The option buyer pays a premium to the counterparty providing the option. Should the exercise date arrive and the market price is lower than the strike price set in the option, the option buyer will take advantage of the transaction and sell allowances to the option seller for the agreed upon strike price. If the market price is above the strike price, the option buyer will forgo exercising the option and take its allowances to the over-the-counter market to garner a larger sale price. This is type of option is known as a *put option*, and the option buyer's risk of decreasing prices (known as the downside risk) is limited to the cost of the option premium.

(C.) Hybrid Structures

At the core of the advanced structures discussed above is a focus on managing price risk. Price risk can vary depending on one's perspective and therefore, requires varying management strategies. The numerous tools available in emissions trading markets can be used in varying combinations and at different times in order to execute a comprehensive market strategy to protect both upside and downside risk. There is no limit on the combinations of these risk management tools, and with the increasing volume and sophistication of emissions markets, new combinations and variations emerge frequently.

The creative use of calls and puts is one example. The basic option tools of calls and puts are being combined and utilized in creative ways to manage risk in increasingly sophisticated ways. Calls and puts on their own allow the buyer to hedge price risk in one direction, either the upside risk for buying allowances or the downside risk for selling allowances. However, hybrid structures can mitigate price risk in both directions at the same time.

Below are a few basic hybrid structures that are currently being employed by market participants. These combinations should present an idea of the potential for customizing the use of these tools.

Collars

Active participants in emissions markets are constantly keeping an eye on their buy and sell positions, finding their upside and downside risk often intertwined. One way to hedge against prices moving in either direction is to simultaneously buy a call option and sell a put option. This allows the market participant to set a price ceiling for purchasing allowances but, at the same time, establish a price floor for selling allowances.

Here is an example. To hedge against the risk of market prices going above $200 an allowance, a utility buys a call option with this strike price for a premium of $10. At the same time, a utility may be willing to sell allowances for not less than $150. In this case, the utility sells a put option with a strike price of $150 for a premium of $10. If price goes above $200, the utility exercises the put, buys at $200, and saves money. Or, if price drops below $150 the utility sells at $150 and makes a profit. With these transactions the utility "collared" its price risk, and the options have cancelled each other out. This equates to a "zero-cost" *collar*.

Strangles

Assume a utility, having just updated its compliance plan, projects that it will be able to meet compliance requirements for several years out into the future. The utility does not have a need to go into the market to purchase allowances to meet compliance targets, and it does not anticipate having excess allowances to sell. Nonetheless, the utility's projections can change over time if, for example, it experiences an abnormally hot or mild summer. This situation would leave the utility with a surplus or deficit of allowances and the corresponding risk of price changes.

In order to hedge against this risk, the utility could execute a *strangle*. The strangle is another combination of a call and a put. It involves buying both call and put options at different strike prices. To protect against the risk of rising allowance prices in case the utility needs to buy allowances in the future, it can purchase a call option with a strike price higher than the current allowance market spot price. This is called an *out-of-the-money call option*. At the same time, the utility can protect itself from the risk of decreasing allowance prices in the event it finds itself long on allowances. This can be done by purchasing a put option with a strike price lower than the current allowance market spot price. This is known as an *out-of-the-money put option*. The out-of-the-money options typically sell for premiums that are lower than the premiums for options with strike prices closer to actual market price. Like a collar, the strangle allows the utility to protect against unforeseen price risks, but also enables it to save money on options.

Selling Covered Call Options

Market participants with excess allowances can use the market to maximize the value of their portfolio while hedging the risk that a drop in price will diminish the value of their holdings. For example, a utility holding excess allowances could start by selling out-of-the-money call options, which give it the right to purchase a set of allowances at a price currently above the market price. This allows the utility to collect a premium against its excess allowance inventory.

If prices stay stagnant or decrease, the buyer of the call option will simply go the market to purchase allowances, while the utility collects the premium and retains ownership of the allowances. On the other hand, if the market price rises above the call strike price, the option buyer will likely exercise the option and purchase the contracted allowances. The utility has collected the premium and transferred allowances. Typically, the utility does not sell options for all of its allowances and so it can then sell additional allowances into the market at the higher market price. Or, the utility can sell another call option, going through the same process.

Writing Covered Put Options

The same strategy employed for covered call options can be used to take advantage of downward movements in price while on the buy end of the transaction. This will also protect the utility against upward swings in prices should it be in a position where it needs to purchase allowances. The utility can sell out-of-the-money put options, or options that have a strike price at lower than the current market price for allowances. As usual, the utility collects a premium against its ability to buy allowances and the purchaser of the option gets the right to sell the utility allowances at a certain price.

If emission allowance prices stay stagnant or trend upward, the purchaser of the covered put option is likely to sell its allowances in the over-the-counter market where it can get prices higher than the strike price of the covered put option. The utility, as the seller of the option, simply receives the option premium. If prices begin to fall, the purchaser of the option will now exercise the covered put option and sell allowances to the utility at the strike price. In this case, the utility usually has more allowances to purchase and is presented with the opportunity to sell another put option (and reap another premium) or buy inventory at lower market prices.

Other Issues

This Handbook has attempted to give the reader an introduction to the cap and trade policy framework and the various transaction tools used in emission trading. Participants can creatively use combinations of these tools to meet various compliance, risk management and profit-making strategies.

That said, however, there are other considerations which may influence a person or company's decision to trade or to choose the appropriate transaction structure. These issues are beyond the scope of this Handbook, but include, among others, the following:

> **The tax implication of each emissions transfer:** This will change with the structure of the transaction. The emissions trading practitioner should consult with tax professionals to determine the specific implications of their transactions.
>
> **Other regulatory constraints:** The majority of participants in the SO_2 market, for example, are currently regulated utilities, governed, in part, by public utility commissions. The emission trading practitioner should determine which regulatory authorities may play a role in decisions to transact allowances and then work with those authorities to determine what—if any—constraints apply to their trading activities.

(D.) Mississippi Power Company Example

In the Spring of 1999, the Southern Company's emissions forecasts indicated that one of its subsidiary operating companies, Mississippi Power Company, would not have sufficient allowances for compliance in the year 2000. This was due to a number of factors, but the bottom line was that the revised SO_2 emissions for the company's power plants were higher than projected. Hence, it would be approximately 10,600 allowances short the following year. Southern's environmental compliance personnel ran a quantitative analysis to determine the best course to ensure Mississippi Power's continued compliance. After running through scenarios involving plant dispatch, fuel switching, and the application of emissions reductions technology, the company determined that picking up allowances in the emissions trading market would be the most cost-effective short-term strategy.

But how would Southern participate in the market? The company could seek out bilateral trades with other market participants, including utilities and traders. Southern, the largest electricity generator in the U.S., feels it does not always get the best over-the-counter prices from traders who may price deals with Southern's deep pockets in mind. As a result, Southern turned to a market broker, Natsource, LLC, allowing it to benefit from detailed market information and to maintain its anonymity in the marketplace.

Structure

The broker first worked with Southern to investigate different structures for its allowance purchase, factoring in Mississippi Power's allowances needs and a consideration of its cash flow situation. Mississippi Power did not require the allowances until the end of 2000, but the company wanted to lock in the purchase price immediately. Cash flow considerations stipulated that the company wanted to match its outlay of funds to the delivery of the allowances. The broker and Southern determined a forward settlement structure was the best course of action.

Sourcing

Before Southern could take its bid to market, however, the broker would have to determine whether the market could absorb it. The trading market for SO_2 is still thin relative to more established commodity markets. Major block trades, which at times cannot be accommodated by active buyers or sellers, could disrupt the market. Instead, large trades are often placed in multiple small blocks. After taking a look at the prevailing offer depth, current volume of the market, and the size of recent deals, the broker counseled that the 10,600-allowance bid by Southern could be readily placed in one block. The only preparatory step left was to determine pricing.

Pricing

The broker's daily participation in the marketplace allowed it to provide Southern with the current range of bids to purchase and offers to sell in the over-the-counter emissions allowance market. However, Southern's transaction on behalf of Mississippi Power was structured to be a forward settlement, and in the existing emissions market, there are few standing bids and offers for specific forward settlement structures. In this case, the broker was able to assist Southern in determining an appropriate bid price by taking a look at the up-to-the-minute spot market for allowances and calculating the market carry cost for the seller. With a target price in hand, Southern set its bid price somewhat lower, leaving room for negotiation in the marketplace.

Placing the Bid

With the opening bid price in hand, the broker turned to the market, contacting active sellers that were offering allowances in the over-the-counter market. The broker gauged the sellers interest in structuring a forward settlement deal, and one came back with an offer, albeit higher than Southern's initial bid. A market had been created, and the broker immediately communicated the offer to Southern.

Negotiating Price

Southern had the option of buying at the offer price, or, as is typical, revising its bid and presenting a counter. The broker worked closely with Southern to advise the utility on what bids were achievable in the market. With a counter in hand, Southern returned to the market with a slightly higher bid, but one that came in below the initial offer. The broker then continued to communicate offers and bids until they found an offer in the marketplace that both Southern and its counterparty were willing to accept.

Consummating the Deal

Once an agreed to trading price was established, Southern and its counterparty verbally confirmed the deal over the phone. The broker read the commercial terms of the deal over the phone and asked both parties if there were any further questions. With no further issues to address, the broker then asked both parties if they agreed to the terms. Both sides agreed, at which point the broker introduced them to each other—the first time either became aware of the other's identity.

Contracting

At this point, the broker stepped away from the transaction, leaving Southern and its counterparty to complete the contracting phase directly. SO_2 trading has become a straightforward process with standard contracting documentation. Southern then signed the contracts and reported the trade to the EPA's Allowance Tracking System. With the transaction complete, the allowances are set to be delivered into Southern's account for Mississippi Power in 2000.

Chapter V. More Applications for Cap and Trade

So far, the Handbook has discussed the basics of cap and trade and participation in emissions trading markets in the context of the U.S. Acid Rain Program. The remainder of the Handbook will provide an overview of two other programs that employ the framework of cap and trade systems. In addition, the Handbook will review two potential applications of cap and trade principles.

(A.) RECLAIM: Cap and Trade as Part of the Solution for Smog in L.A.

Smog has become a part of daily life in the Los Angeles region. Smog is known to affect children, the elderly and asthmatics. Recent studies are also linking it to long-term respiratory illness and impaired lung capacity. The smog in Los Angeles is a major health concern for the area's citizens.

The area is under pressure to meet national health standards for air quality by 2010. In turn, industries and businesses have been tasked to cut emissions of the smog producing pollutants nitrogen oxides (NO_x) and sulfur oxides (SO_x). The emissions cuts amount to fully 80% reductions by 2003.

Market-based Solution Sought

In 1993, the *Regional Clean Air Incentives Market* or RECLAIM was established. It is the market-based policy tool that local governments are using to achieve reductions at a select group of sources. Under RECLAIM, a market for NO_x and a market for SO_2 have been created. The program is administered by the *South Coast Air Quality Management District (SCAQMD)*, a governmental agency covering Los Angeles, Orange, and Riverside counties and portions of San Bernardino county.

Stationary sources in the Los Angeles area emitting more than four tons of NO_x and SO_2 annually have their emissions capped to preserve environmental benefits. Those caps are then gradually decreased to ensure steady improvement in the overall air quality. Under the declining cap, these sources have been assigned three emissions targets for NO_x and SO_2 which include an initial allocation in 1994, the mid-point reduction in 2000, and ending allocations in 2003. Basinwide, by the year 2003, NO_x emissions from RECLAIM sources are to be reduced by 75% and SO_x emissions by 61%.

As with the U.S. Acid Rain Program, sources can conserve credits by reducing emissions to a level that is lower than their target. These RECLAIM Trading Credits (RTCs) then become an asset that is fully transferable and can be freely traded. Transparency is vital to the program's success. The SCAQMD maintains a registry and keeps a public bulletin board listing each facility's emissions record, allocations, and compliance activity.

Compliance for affected sources comes on a staggered 12-month cycle. At the end of the year, operators of affected sources make their final annual report to the SCAQMD, but still have the benefit of a two-month reconciliation period. During this time, a facility lacking sufficient RTCs to cover their emissions can enter the RTC market to make up for its shortfall. Similar to the U.S. Acid Rain Program, stiff penalties strongly encourage compliance. Facilities failing to meet requirements have RTCs deducted from their account the following year and are subject to monetary penalty.

With a fully operational cap and trade program in place in the Los Angeles area for more than a half-decade, the results are already apparent. SO_x and NO_x emissions from affected sources have been successfully reduced, although there is still much more to go. The most striking benefit of the RECLAIM program has been its dramatic effect on the economic impact of reductions. It was once thought that NO_x credits would trade at around $25,000 per ton, however, the recent RECLAIM market price is roughly $640 to $5,560 per ton. At the outset of the program, the SCAQMD projects annual savings in compliance costs relative to command and control regulation averaging $58 million annually or 42%. However, while RTC costs are far below projections, actual savings have been far greater. These gains notwithstanding, additional environmental benefits and the real economic test for the RECLAIM program will occur next year when the next set of reductions are mandated.

For more information check these Web addresses:
http://www.aqmd.gov/

(B.) OTC NO_x - Regional Ozone Program in Place

As the federal SO_2 program demonstrates, acid rain presents a complex set of problems for policy makers, regulators, environmentalists, and American industry. When compared to NO_x controls, however, the SO_2 program seems relatively straightforward.

NO_x contributes to the acid rain problem nationwide and it contributes to the ground level ozone problems in the East and in certain densely populated areas in the rest of the country. In relation to acid rain, the concern about NO_x is the issue of *accumulation*. The pollutant's effects build up over time and can have a lasting effect on the environment. In relation to ozone, the concern is about *acute loading* in which the build up of NO_x emissions at any given time during the summer season is when the environmental and health impact is most great.

It is these temporal and spatial concerns that have influenced the design of NO_x trading programs. Power plants in the Northeast increase generation in the summer months to meet their customers' needs for more electricity to run their air conditioners. These power plants are also emitting nitrogen oxides (NO_x) that, combined with summer sunshine and other pollutants known as volatile organic compounds (VOCs), create *ground-level ozone* across the northeast region. Northeastern states have adopted a multi-state approach to address these concerns.

What is Ozone?

Ozone is a gas that forms in the atmosphere when 3 atoms of oxygen are combined (0_3). It is not emitted directly into the air, but is created by a chemical reaction between oxides of nitrogen (NO_x), and volatile organic compounds (VOC) in the presence of sunlight. Ozone has the same chemical structure whether it occurs high above the earth or at ground level and can be "good" or "bad," depending on its location in the atmosphere.

How Can Ozone Be Both Good and Bad?
Ozone occurs in two layers of the atmosphere. The layer surrounding the earth's surface is the troposphere. Here, ground-level or "bad" ozone is an air pollutant that damages human health, vegetation, and many common materials. It is a key ingredient of urban smog. Above the troposphere is the stratospheric or "good" ozone layer, extending upward from about 10 to 30 miles and protecting life on earth from the sun's harmful ultraviolet rays (UV-b).

What is Happening to the "Good" Ozone Layer?
Ozone occurs naturally in the stratosphere and is naturally produced and destroyed at a constant rate. But this "good" ozone is being destroyed at an accelerating rate by manmade chemicals called chlorofluorocarbons (CFCs), halons, and other ozone depleting substances (used in coolants, foaming agents, fire extinguishers, solvents, and aerosol propellants).

It can take years for ozone depleting chemicals to reach the stratosphere, and even though we have reduced or eliminated the use of many CFCs, their impact from years past is just starting to affect the ozone layer. Ozone depleting substances released into the air today will contribute to ozone destruction well into the future.

How Does the Depletion of "Good" Ozone Affect Human Health and the Environment?
Increased UV-b can lead to more cases of skin cancer, cataracts, and impaired immune systems. Damage to UV-b sensitive crops, such as soybeans, reduces yield. High altitude ozone depletion is suspected to cause decreases in phytoplankton, a plant that grows in the ocean. Phytoplankton is an important link in the marine food chain and, therefore, food populations could decline.

What Causes "Bad" Ozone?
Fossil fuel combustion, motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents are some of the major sources of NO_x and VOC, also known as ozone precursors. Strong sunlight and hot weather cause ozone to form in harmful concentrations at ground level. Ozone and its precursors can travel hundreds of miles in winds, this is known as ozone transport. Many urban areas have high levels of ground-level ozone because they have high levels of local ozone precursor emissions. Other, less populated areas also experience high ozone levels due to ozone transport.

How Does "Bad" Ozone Affect Human Health and the Environment?
Repeated exposure to ozone pollution is suspected to cause permanent damage to the lungs. Even when ozone is present in low levels, inhaling it triggers a variety of health problems including chest pains, coughing, nausea, throat irritation, and congestion. It also can worsen bronchitis, heart disease, emphysema, and asthma, and reduce lung capacity. "Bad" ozone damages the foliage of trees and other plants, ruining the landscape of cities, national parks and forests, and recreation areas. Ozone damage also reduces agricultural output.

Source: U.S. EPA

The Clean Air Act Amendments of 1990 set *National Ambient Air Quality Standards (NAAQS)* for ground-level ozone that must be met by states across the country. In the Clean Air Act, Congress also established the *Ozone Transport Commission (OTC)*, a working group made up of twelve Northeast states and the District of Columbia to assist states in the Eastern U.S. to meet these targets. The OTC created a NO_x Budget Program to help reduce regional ozone levels.

The OTC's efforts included the September 1994 signing of a memorandum of understanding with the EPA. The agreement, signed by all OTC states except Virginia, put in place a cap and trade system with boundaries reflecting the regional nature of the problem.

OTC States

Connecticut	Delaware
District of Columbia	Maine
Maryland	Massachusetts
New Hampshire	New Jersey
New York	Pennsylvania
Rhode Island	Vermont
Virginia	

Compliance In Summer Months

The OTC agreement caps NO_x emissions at 219,000 tons during the compliance period for the years 1999 - 2000 and 143,000 tons starting with the compliance period in 2003. This is less than half the 1990 baseline of 490,000 tons. The cap affects 465 sources of

NO_x in participating OTC states, including utilities, independent power producers, and industrial facilities. The compliance period for the program runs from May through September, addressing the seasonal nature of the ground-level ozone problem.

As with all programs covered under Title I of the Clean Air Act, the OTC NO_x trading programs is a state compliance measure. States establish their own rules, which include allocation strategies and other measures. Efforts were made to ensure that rules were consistent from state to state to allow for regional emissions trading, however, program aspects such as emissions allocation methodology do vary considerably between states. Also, EPA acts as an agent for the states by administering the allowance tracking system. Each allowance in the OTC trading program is equal to one ton of NO_x released into the atmosphere during the compliance period. The allowances are fashioned to be standardized and tradable, but bankable only in limited amounts.

The limit on banking is a design feature that addresses the particular temporal and spatial concerns about ozone formation. Significant inroads to reduce NO_x emissions had to be reached each season or the environmental gains would be limited. This dynamic precluded long-term banking provisions.

Trading Market Already Developed

Like other cap and trade programs, affected utilities and industry sources can reduce NO_x emissions below their allocation, leaving them with surplus allowances to trade in the marketplace. Those utilities with more emissions than allowances also have the flexibility to find the most economic way to meet their targets, including turning to the market for allowances.

The OTC market has already steadily developed in its first season. Trading began in 1998 for compliance activities related to the 1999 summer season. According to one estimate, over 35,000 tons were traded before the start of the 1999 season. Information on current volumes and prices for NO_x allowances can be obtained from emissions trading brokers, as well as publications such as *Air Daily* and the *Utility Environment Report*.

The market also exhibited signs of maturation as trades for future vintage allowances also have been made, with prices reflecting the emerging spreads between current vintage year allowances and those of future years. Similar spreads are evident in SO_2 allowance markets, as well.

For more information check these Web addresses:
http://www.epa.gov/oar/
http://www.epa.gov/acidrain/noxpg.html

(C.) Potential Applications for Cap and Trade

As stated earlier, cap and trade is viewed by many as a model that may be appropriate for other environmental programs on a regional or global scale. Recently, cap and trade is being examined in the context of two other environmental problems: ozone transport and global climate change.

Ozone Transport

The regional problem of ground-level ozone in the Northeast, which is being addressed by the Ozone Transport Commission and its cap and trade program, is only partly caused by polluting sources from that area. Major coal burning power plants in the Midwest and South are releasing NO_x into the atmosphere, which is being carried eastward on prevailing winds.

Seeking to stem the effects of ground level ozone on human health and the environment, policy makers were again looking for a regional solution—but one that would extend its parameters borders to reach all relevant sources. As a result, the 37 eastern-most states in the country joined with industry, environmentalists, and the EPA to address the issue of long-range transport of NO_x emissions. The interested parties formed the *Ozone Transport Assessment Group*, and in September 1998, EPA promulgated a rule seeking additional NO_x emissions reductions to address the problem of ozone transport. This rule making is commonly known as the NO_x SIP Call.

SIP Call States

Alabama	Connecticut
Delaware	District of Columbia
Georgia	Illinois
Indiana	Kentucky
Maryland	Massachusetts
Michigan	Missouri
New Jersey	New York
North Carolina	Ohio
Pennsylvania	Rhode Island
South Carolina	Tennessee
Virginia	West Virginia
Wisconsin	

Under the Clean Air Act, all states have to prepare SIPs or *state implementation plans*. The NO_x SIP call requires the twenty-two eastern most states to include provisions for addressing ozone transport in their SIPs. NO_x emissions reductions are to be achieved by the 2003 compliance season. Levels of NO_x emissions are to be cut by 28% or by 1.1 million tons a year. The EPA rule allows states to consider cap and trade programs in their SIPs.

Climate Change

Global climate change could have a very profound impact on the way we live our lives, and stakeholders around the world are looking for effective and pragmatic solutions. Human activities like burning fossil fuels in cars, airplanes, and in power generation are releasing greenhouse gases. The accumulation of greenhouse gases in the atmosphere are thought to contribute to a rise in worldwide temperatures. The greenhouse effect occurs when greenhouse gases act like a blanket and trap heat from the sun that would otherwise escape back out into space.

The problem associated with greenhouse gases is thought to be one of accumulation. Greenhouse gas emissions contribute to climate change regardless of where the emissions occur, and climate change can be addressed by reductions in greenhouse gas emissions no matter where they occur. This suggests that emissions trading could be a useful tool in addressing climate change.

Greenhouse Gases

Greenhouse Gas	Chemical Formula	Global Warming Potential*
Carbon Dioxide	CO_2	1
Chloroform	CHC_{13}	4
Methane	CH_4	21
Nitrous Oxide	N_2O	310
Perflouro-carbons	CxFx	6,5000 –9,2000
Sulphur Hexafloride	SF_6	23,900

*The GWPs of greenhouse gases have been established by the Intergovernmental Panel on Climate Change (IPCC), the scientific body to the United Nations Framework Convention on Climate Change. The GWP measures the contribution of individual gases to climate change over a 100-year period, enabling all greenhouse gases to be measured in CO2 equivalents. For example, 1 ton of Chloroform is the equivalent of 4 tons of carbon dioxide.

Source: Natsource, Inc.

A series of reports by the United Nations outlining concerns about climate change compelled world leaders to action. International momentum led to a global summit in Rio de Janeiro, Brazil in 1992. The participating nations signed several documents including the *United Nations Framework Convention on Climate Change*, in which over 180 nations committed to an objective of preventing dangerous interference in the world's climate system.

The Framework Convention guided several additional international meetings in the succeeding years, and these discussions resulted in the *Kyoto Protocol*. Adopted in 1997, the Kyoto Protocol would commit 38 industrialized countries to reduce greenhouse gases an average of 5.2% from 1990 levels over the period between 2008 and 2012. The Protocol has not yet been brought before the US Senate for ratification.

The Kyoto Protocol has provisions for emissions trading as a mechanism under the agreement. Emissions trading would allow the marketplace to identify the lowest-cost reduction options.

Key questions remain, not the least of which is who would be allowed to trade, what they would trade, and how it would be traded. Nonetheless, countries

Kyoto Protocol: Article 17

"The Conference of Parties shall define the relevant principles, modalities, rules and guidelines, in particular for verification, reporting and accountability for emissions trading. The Parties included in Annex B may participate in emissions trading for the purpose of fulfilling their commitments under Article 3. Any such trading shall be supplemental to domestic actions for the purpose of meeting quantified emissions limitations and reduction commitments under that Article."

and private entities are beginning to explore the viability of greenhouse gas emissions trading. A handful of trades have already been executed, and most market participants expect trading to ramp up once the future of international markets is made more clear.

For more information check these Web addresses:
http://www.epa.gov/ttn/
http://www.epa.gov/globalwarming/
http://www.unfccc.de

Chapter VI. Glossary

The following terms are defined as indicated for their use in this Handbook.

A

Accumulation: the build up of a particular pollutant over time

Acid Rain: term applied to acid precipitation formed when emissions of sulfur dioxide (SO_2) and oxides of nitrogen (NO_x) react in the atmosphere with water and other compounds

Acid Rain Program: created under the Clean Air Act to reduce acid rain; employs a cap and trade framework to achieve SO_2 reductions

Acute Loading: a term that applies to the short-term build up of a pollutant and which suggests that, in the short-term, significant amounts of a pollutant can accumulate

Allowance: the term generally used to refer to the emission reduction unit traded in emissions trading programs; in the Acid Rain Program this term specifically means the limited authorization to emit one ton of SO_2 during a given year.

Allowance Loan: transaction wherein an owner of allowances, the lender, allows another party, the borrower, to use the allowances. The borrower customarily promises to return the allowances after a specified period of time with payment for their use, called interest. The allowances returned are not necessarily the exact ones loaned, but are allowances of similar vintage years

Allowance Loan Rate: payment for the lending of allowances over a specified period of time, calculated including the cost-of-carry charge

Allowance Tracking System (ATS): a computerized system administered by EPA and used to track the allowances and allowance transactions by all market participants

Allowance Transfer Form (ATF): official form used to report allowance transfers to the ATS. The ATF lists the serial numbers of the allowances to be transferred and includes the account information of both the transferor and the transferee

Ask: the price a prospective seller is willing to accept (a.k.a. “offer”)

Average Weighted Price: calculation used to determine price taking into account the quanity of allowances sold

B

Bear Market: prolonged period of falling allowance prices.

Bid: price a prospective buyer is willing to pay

Broker: person who acts as an intermediary between a buyer and a seller, usually charging a commission

Bubble: a regulatory term which applies to the situation when a company combines a number of its sources in order to control pollution in aggregate; under a bubble facility operators are allowed to choose which sources to control as long as the total amount of emissions from the combined sources is less than the amount each source would have emitted under the conventional requirement

Bull Market: prolonged rise in the price of allowances. Bull markets usually last at least a few months and are characterized by high trading volume

C

Call Option: a contract that grants the right to buy, at a specified price, a specific number of allowances by a certain date

Clean Air Act Amendments of 1990: reauthorization of the Clean Air Act; passed by the U.S. Congress; strengthened ability of EPA to set and enforce pollution control programs aimed at protecting human health and the environment; included provisions for Acid Rain Program

Clearing Price: price at which a buyer and seller agree to transact a trade

Collar/Zero-cost Collar: set of contracts used to hedge against the risk of prices moving in both directions; involves purchasing a call option and selling a put option. Option premiums in a collar that cancel each other out are “zero-cost” collars

Confirmation Sheet: formal memorandum from a broker to a client giving details of an allowance transaction

Cost-of-carry: out-of-pocket costs incurred while an allowance holder retains allowances for future transfer

Counterparty: the party opposite the buyer or seller in a transaction

Credit Risk: the financial risk that an obligation will not be paid and a loss will result

D

Deferred Swap: a trade of one allowance for another in order to exchange the vintage years of the allowances; settlement occurs after more than 180 days

Demand-side: a term referring to the need (or demand) for power generation among a utility's customers

Designated Representative: for a unit account, the individual who represents the owners and operators of that unit and performs allowance transfer requests and all correspondence with EPA concerning compliance with the Acid Rain Program; for general accounts this refers to the person who is authorized to transact allowances from each account

Dispatch: the ordered use of generation facilities by an electric power utility including which units will operate, when they will operate, and at what capacity

E

Exercise Date (or Expiration Date): last day on which an option can be exercised

F

Forward Settlement: purchase or sale of a specific quantity of allowances at the current or spot price, with delivery and settlement scheduled for a specified future date

G

General Accounts: accounts in the SO_2 or NO_x ATS's which were created after the initial allocation; general accounts can be opened by any individual and they are not automatically adjusted for compliance

Global Climate Change: change in the earth's climate; caused by increasing greenhouse gas (GHG) concentrations in the atmosphere; human activities considered to be major new source of GHGs

Greenhouse Gases: variety of gases including carbon dioxide, methane, and nitrous oxide; the buildup of these gases in the atmosphere prevents energy from the sun to escape back out into space, creating the "greenhouse effect"

Ground-level Ozone: the occurrence in the troposphere (at ground level) of a gas that consists of 3 atoms of oxygen (0_3); formed through a chemical reaction involving oxides of nitrogen (NO_x), volatile organic compounds (VOC), heat and light; At ground level, ozone is an air pollutant that damages human health, vegetation, and many common materials and is a key ingredient of urban smog.

H

Hedge: strategy used to offset investment risk. A perfect hedge is one eliminating the possibility of future gain or loss

I

Immediate Settlement: conclusion of an allowance trade in which a party pays for allowances within days of the confirmation of the transaction

Immediate Vintage Year Swap: an trade of one allowance for another in order to exchange the vintage years of the allowances; settlement occurs within days (or at least less than 180 days)

J

K

Kyoto Protocol: an agreement under the UNFCC signed by 84 nations; establishes greenhouse gas targets ("budgets") and framework for implementation; the Protocol has been agreed to and signed by the U.S. and now awaits ratification by the U.S. Senate

L

Long: a market position in which a party records (or anticipates recording) emissions less than its yearly emissions allocation, thus it has surplus allowances

Long-term Forward purchase or sale of a specific quantity of allowances, with delivery and settlement scheduled for a specified future date, usually more than one year out

M

Market Maker: an individual or company that maintains firm bid and offer prices in allowances by standing ready to buy or sell allowances at market prices

N

National Ambient Air Quality Standards (NAAQS): health-based standards for a variety of pollutants set by EPA that must be met by states across the country

Natural long: a party whose allowance allocation is greater than its actual emissions

Natural short: a party whose allowance allocation is less than its actual emissions

Nitrogen Oxides (NO_x): gases produced during combustion of fossil fuels in motor vehicles, power plants and industrial furnaces and other sources; is a precursor to acid rain and ground-level ozone

NO_x Budget Program: a NO_x cap and trade program adopted by 13 jurisdictions in the Northeast to address ozone transport in that region

O

Offers: price at which someone who owns an allowance is willing to sell (a.k.a. "Ask")

Option: a contractual right to buy or sell allowances at an agreed price; the option buyer pays a premium for this right. If the option is not exercised after a specified period it expires

Option Premium: amount per share paid by an option buyer to an option seller for the option

Out-of-the-money Call Option: term used to describe an call option whose strike price for an allowance is higher than the current market value

Out-of-the-money Put Option: term used to describe a put option whose strike price for an allowance is lower than the current market value

Over-the-counter Market: Market in which allowance transactions are conducted through the direction interaction of counterparties rather than on the floor of an exchange

Ozone Transport Assessment Group (OTAG): a multi-stakeholder workgroup convened to address problems associated with the long-range transport of ozone and its precursors; encompassed stakeholders in 37 jurisdictions

P

Put Option: a contract that grants the right to sell, at a specified price, a specific number of allowances by a certain date

Power Pool: a situation where output from different power plants are "pooled" together, scheduled according to increasing marginal cost, technical and contractual characteristics (so-called must-runs), and dispatched according to this "merit order" to meet demand

Q

R

Regional Clean Air Incentives Market (RECLAIM): initiated in 1993; a set of market initiatives designed address air pollution in the Greater Los Angeles area of California; includes cap and trade programs for NO_x and SO_x

Retire (Allowances): to remove a portion of allowances from the market

S

Scrubbers: a pollution control technology utilized in power plants to remove pollutants from plant emissions

Short: a market position in which a party records (or anticipates recording) emissions in excess of its yearly emissions allocation, thus it has a deficit of allowances

Short-term Forward: purchase or sale of a specific quantity of allowances at the current or spot price, with delivery and settlement at a specified future date, usually within one year

Smog: originally meaning a combination of smoke and fog, smog now generally refers to air pollution; ground level ozone is a major constituent of smog

SO_2 Allowance Auction: provided for in the Clean Air Act, the SO_2 auction is held annually by the US EPA; the auctions help to send the market an allowance price signal, as well as furnish utilities with an additional avenue for purchasing needed allowances

South Coast Air Quality Management District (SCAQMD): the air pollution control agency for the four-county region including Los Angeles and Orange counties and parts of Riverside and San Bernardino counties

Special Allowance Reserve: roughly 2.8 percent of the cap set aside each year to supply the annual allowance auction

State Implementation Plan (SIP): the plan that each state must develop and have approved by the US EPA which indicates how the state will comply with the requirements in the Clean Air Act; each State's SIP is amended as they address specific or new requirements such as the NO_x reductions required in the NO_x SIP Call

Strangle: sale or purchase of a put option and a call option on the same underlying instrument, with the same expiration, but at strike prices equally out of the money.

Strike Price (or Exercise Price): price at which the allowance underlying a call or put option can be purchased (call) or sold (put) over the specified period.

Sulfur Dioxide (SO_2): a gaseous pollutant which is primarily released into the atmosphere when as a by-product of fossil fuel combustion; the largest sources of SO_2 tend to be power plants that burn coal and oil to make electricity

Supply-side: a term referring to the generation (or supply) of power by a utility

Swap: an exchange of one allowance for another to exchange the vintage years of the allowances held in accounts

T

Time Weighting: an investment strategy in which allowance purchases and sales are transacted over an extended period of time and in small increments, thereby eliminating risk associated with highs and lows in the market

Trader: anyone who buys or sells allowances with the intention of making a profit

U

Unit Accounts: accounts in the SO_2 or NO_x ATS's which hold allowances initially allocated to those sources required to participate in either the acid rain or OTC NO_x programs; EPA adjusts these accounts for compliance each year

United Nations Framework Convention on Climate Change(UNFCC): a treaty signed in 1992 by 165 countries and ratified by 160 countries (including the U.S.); took effect in March 1994; set a target of stabilizing greenhouse gas concentrations in the atmosphere to a level that would prevent dangerous anthropogenic interference with the climate system; established a framework for agreeing to specific actions

V

Vintage Year: represents the first year in which the allowance can be used for compliance

W

X

Y

Z

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