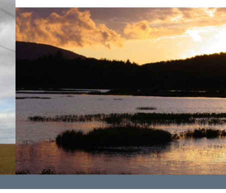
Acid Rain and Related Programs: 2008 Emission, Compliance, and Market Analyses



The Acid Rain Program (ARP), established under Title IV of the 1990 Clean Air Act Amendments, requires major emission reductions of sulfur dioxide (SO_2) and nitrogen oxide (NO_x), the primary precursors of acid rain, from the electric power industry. The SO_2 program sets a permanent cap on the total amount of SO_2 that may be emitted by electric generating units (EGUs) in the contiguous United States. The program is phased in, with the final 2010 SO_2 cap set at 8.95 million tons, a level of about one-half of the emissions from the power sector in 1980. NO_x reductions under the ARP are achieved through a program that applies to a subset of coal-fired EGUs and is closer to a more traditional, rate-based regulatory system. Since the program began in 1995, the ARP has achieved significant emissions reductions. As Figure 1 shows, these reductions have occurred as electricity generation has increased.

At a Glance: ARP Results in 2008

SO_2 Emissions: 7.6 million tons

SO_2 Compliance: 100%

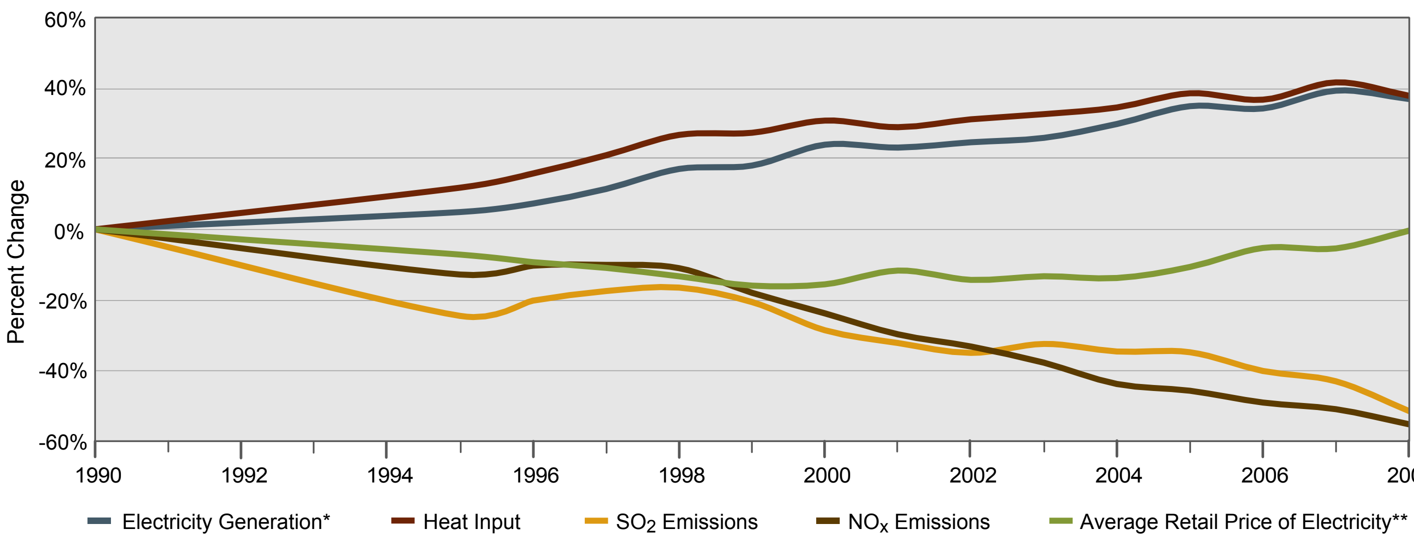
SO_2 Allowances: Banked allowances increased by almost 2 million from 2007 levels

SO_2 Allowance Prices: Since July 2008, allowance prices have fallen sharply, with a monthly average nominal price in May 2009 of $71/ton

NO_x Emissions: 3.0 million tons

NO_x Compliance: 100%

Figure 1: Trends in Electricity Generation, Fossil Energy Use, Prices, and Emissions from the Electric Power Industry, 1990–2008

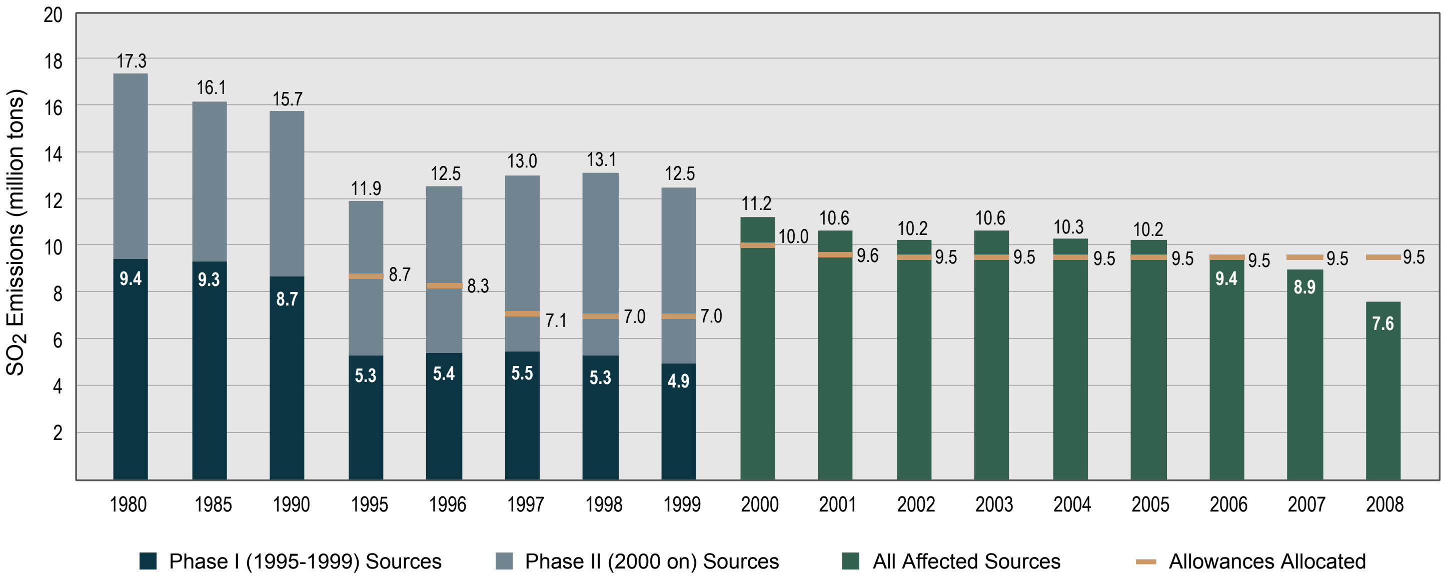


* Generation from fossil fuel-fired plants.

** Constant year 2000 dollars adjusted for inflation.

Source: Energy Information Administration (electricity generation, retail price); EPA (heat input and emissions, representing all affected ARP units), 2009

Figure 2: SO_2 Emissions from Acid Rain Program Sources, 1980–2008



Source: EPA, 2009

Over the next several months, EPA will release a series of reports summarizing progress under the ARP. This second report analyzes 2008 data on emission reductions, reviews compliance results, and summarizes market activity. A future report will compare changes in emissions to changes in acid deposition and surface water chemistry. For more information on the ARP, please visit: <www.epa.gov/airmarkets/progsregs/arp/index.html>.

SO_2

SO_2 Emission Reductions

The SO_2 requirements under the ARP apply to EGUs, fossil fuel-fired combustors that serve a generator which provides electricity for sale. The vast majority of ARP SO_2 emissions result from coal-fired EGUs, although the program also applies to oil and gas units; in total, there were 3,572 EGUs subject to the SO_2 program in 2008. As Figure 2 shows, ARP units have reduced annual SO_2 emissions by 56 percent compared with 1980 levels and 52 percent compared with 1990 levels. Sources emitted 7.6 million tons of SO_2 in 2008, well below the current annual emission cap of 9.5 million tons, and already below the statutory annual cap set for compliance in 2010 of 8.95 million tons.

Reductions in SO_2 emissions from other sources not affected by the ARP (including industrial and commercial boilers and the metals and refining industries) and use of cleaner fuels in residential and commercial burners contributed to a similar overall decline (56 percent) in annual SO_2 emissions from all sources since 1980. National SO_2 emissions from all sources have fallen from nearly 26 million tons in 1980 to about 11.4 million tons in 2008 (see data available at <www.epa.gov/ttn/chief/trends>).

The states with the highest emitting sources in 1990 have generally seen the greatest SO_2 reductions under the ARP. Most of these states are upwind of the areas the ARP was designed to protect, and reductions have resulted in important environmental and health benefits over a large region.

In addition, from 2007 to 2008, reductions in SO_2 emissions from ARP units in 38 states totaled about 1.3 million tons, or about 15 percent for the year. Five states (Georgia, Indiana, North Carolina, Ohio, and Pennsylvania) accounted for most of the one-year reductions from 2007 to 2008, ranging from 119,271 to 244,651 tons of SO_2 in each of these states.

From 1990 to 2008, annual SO_2 emissions in 38 states and the District of Columbia fell by a total of approximately 8.2 million tons. In contrast, annual SO_2 emissions increased by a total of 79,309 tons in 10 states from 1990 to 2008. The seven states with the greatest reductions in annual emissions since 1990 include Ohio, which decreased emissions by over 1.5 million tons, and Illinois, Indiana, Kentucky, Missouri, Tennessee, and West Virginia, each of which reduced total emissions during this time period by more than 500,000 tons. To view emission data in an interactive format using Google Earth or a similar three-dimensional platform, go to <www.epa.gov/airmarkets/progress/interactivemapping.html>.

Why SO_2 Emissions Decreased in 2008

ARP sources decreased SO_2 emissions sharply in 2008, with a 15 percent decline from 2007. A portion of this reduction may be attributable to a decrease in utilization, as heat input in 2008 fell by about 3 percent (See Table 1). The larger cause, however, was the large increase in the number of units that employed flue gas desulfurization (or scrubbers). The number of reported scrubbers climbed by 20 percent, from 246 in 2007 to 295 in 2008. This increase led to a decline in the overall SO_2 emission rate for ARP units—0.64 lb/mmBtu in 2007 versus 0.56 lb/mmBtu in 2008. It is of historical interest that the ARP allowance allocations for Phase II in 2000 were based on an SO_2 emission rate of 1.2 lb/mmBtu.

With the exception of reductions that might have occurred as a result of enforcement actions, most of the SO_2 reductions in 2008 are likely to have resulted from early compliance planning for the Clean Air Interstate Rule (CAIR). Although some states have regulations that will require SO_2 reductions in future years (such as North Carolina's Clean Smokestacks Act in 2009), one reason controls were installed and operated in 2008 was the significant incentive to bank pre-CAIR vintage SO_2 allowances, which could be used on a 1:1 basis under the CAIR annual SO_2 program. In contrast, ARP allowances with later vintage years would be subject to increased retirement ratios under CAIR (2:1 in 2010 through 2014, and 2.86:1 in 2015 and thereafter). Going forward, the decision by the U.S. Court of Appeals remanding CAIR for further rulemaking by EPA might affect sources' compliance planning and the observed trends in SO_2 emission reductions.

Updating the Human Health Benefits of the Acid Rain Program

In 2005, a peer reviewed journal article, "A Fresh Look at the Benefits and Costs of the US Acid Rain Program,"[1] assessed the human health and welfare benefits of ARP implementation for the prospective year 2010. The benefits were estimated using modeled emission reductions and ambient air quality expected to be achieved in 2010 under the ARP. The majority of the monetized benefits of ARP implementation are from the prevention of health-related impacts, such as premature death, due to reductions in ambient concentrations of fine particulate matter ($PM_{2.5}$) and ground-level ozone. This study used the Pope et al., 2002, concentration response function to estimate incidences of adult premature mortality as a result of $PM_{2.5}$ exposure.[2] The results of this study estimated the U.S. $PM_{2.5}$ and ozone health-related benefits of the ARP to be $134 billion and $5.5 billion annually, respectively.[3]

Since publication of this article, the assumptions used to develop human health effects estimates have changed. For example, EPA now also includes concentration response functions derived from the Laden et al., 2006 study[4] and an expert elicitation to estimate incidences of adult premature mortality as a result of $PM_{2.5}$ exposure. Additionally, many underlying modeling assumptions have been updated, including population forecasts and baseline incidence rates. A majority of these updated assumptions are discussed in detail in the recent $PM_{2.5}$ Regulatory Impact Analysis.[5] The revised assessment uses the original modeled ambient air quality[6] and updated health benefits assessment assumptions to update the U.S. $PM_{2.5}$ and ozone related benefits of ARP implementation.

Table 1: SO_2, NO_x, and Heat Input Trends in Acid Rain Program Units, by Fuel Type

Fuel Type	2004			2005			2006			2007			2008		
	SO_2	NO_x	HI	SO_2	NO_x	HI	SO_2	NO_x	HI	SO_2	NO_x	HI	SO_2	NO_x	HI
Coal	9,840	3,484	20.49	9,837	3,356	20.77	9,244	3,208	20.44	8,768	3,069	20.75	7,517	2,816	20.25
Oil	377	138	1.00	349	129	0.99	135	63	0.58	149	68	0.61	84	46	0.48
Gas	36	134	4.83	35	142	5.34	8	131	5.70	10	141	6.32	7	129	6.21
Other	3	6	0.03	3	6	0.03	7	7	0.05	7	5	0.05	10	5	0.06
Total	10,256	3,762	26.34	10,223	3,633	27.13	9,393	3,409	26.77	8,933	3,283	27.74	7,617	2,996	26.99

Notes:

- Emissions are in thousand tons, and heat input data are in quadrillion Btu (Quads). Totals may not reflect individual rows from rounding. Fuel type represents primary fuel type; many electric generating units might combust more than one fuel.
- EPA data in Table 1 and used elsewhere in this report are current as of July 1, 2009, and may differ from past reports as a result of resubmissions by sources and ongoing data quality assurance activities.

Source: EPA, 2009

Table 2: Estimated $PM_{2.5}$ Health Benefits Due to ARP Implementation in 2010

Health Effect	Incidences Avoided	Monetized Value (millions; 2008$)
Adult Mortality[7] from $PM_{2.5}$		
Pope et al., 2002	20,000	$160,000
Laden et al., 2006	50,000	$400,000
Range of Expert Elicitation	7,000 to 66,000	$58,000 to $520,000
Infant Mortality from $PM_{2.5}$		
Woodruff et al.	82	$710
Morbidity from $PM_{2.5}$		
Acute Bronchitis	28,000	$2.2
Acute Myocardial Infarction	30,000	$3,500
Acute Respiratory Symptoms	12,000,000	$790
Asthma Exacerbation	280,000	$15
Chronic Bronchitis	12,000	$5,800
Emergency Room Visits; Respiratory	18,000	$7.2
Hospital Admissions; Cardiovascular	10,000	$300
Hospital Admissions; Respiratory	4,800	$72
Lower Respiratory Symptoms	290,000	$5.6
Upper Respiratory Symptoms	220,000	$6.8
Work Loss Days	2,500,000	$640
Total Value		
Pope et al.		$170,000
Laden et al.		$410,000

Note: Totals may not reflect individual rows from rounding.

Source: EPA, 2009

The results of the revised assessment show an increase in the estimated value of U.S. $PM_{2.5}$ and ozone health benefits expected from ARP implementation in 2010. Depending on whether the Pope or Laden function is used as the primary estimate of incidences of adult mortality avoided, the monetized $PM_{2.5}$ benefit increase ranges from 25 to 204 percent more than was estimated in the 2005 article not-

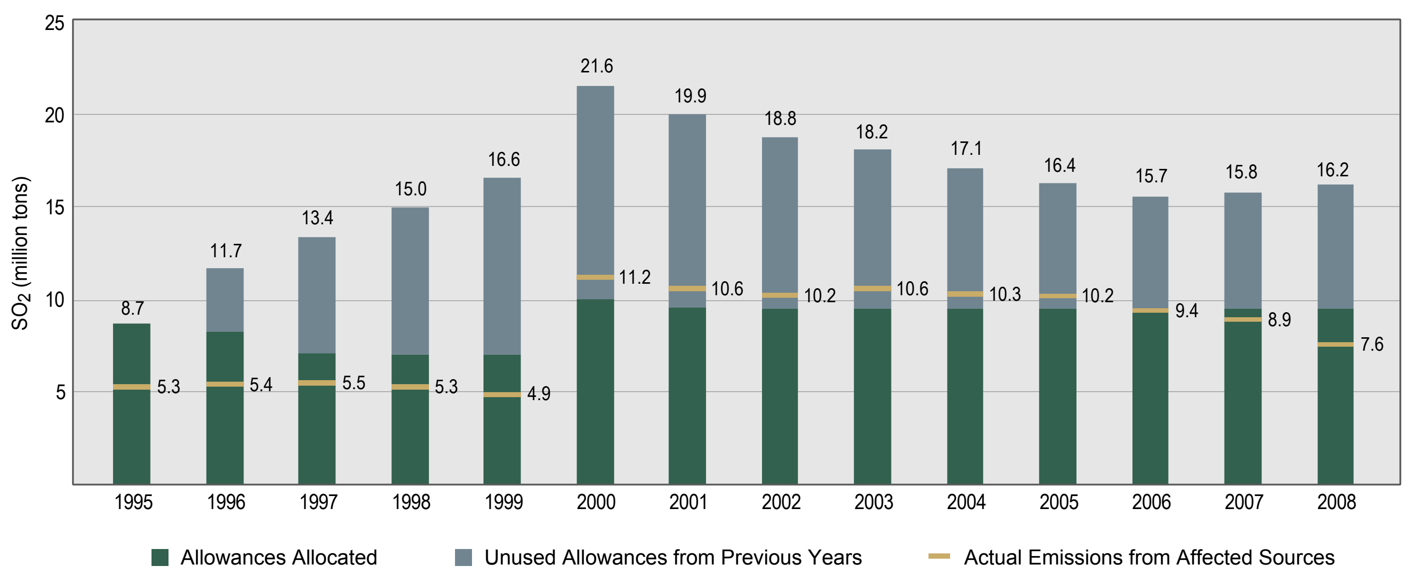
Table 3: Estimated Ozone Health Benefits Due to ARP Implementation in 2010

Health Effect	Incidences Avoided	Monetized Value (millions; 2008$)
Mortality		
Mortality, Non-Accidental (Ito et al., 2005)	1,900	$17,000
Mortality, Non-Accidental (Schwartz, 2005)	660	$5,700
Mortality, Non-Accidental (Bell et al., 2004)	430	$3,700
Mortality, All Cause (Levy et al., 2005)	2,000	$17,000
Mortality, All Cause (Bell et al., 2005)	1,400	$12,000
Mortality, Cardiopulmonary (Huang et al., 2005)	720	$6,200
Morbidity		
Hospital Admissions, Respiratory (age 65 and up)	3,000	$75
Hospital Admissions, Respiratory (age 0-2)	2,500	$26
Emergency Room Visits, Respiratory	1,900	$0.74
School Loss Days	910,000	$87
Acute Respiratory Symptoms	2,600,000	$170
Total Value Range		$4,100 - $17,000

Note: Totals may not reflect individual rows from rounding.

Source: EPA, 2009 (compiled from papers listed in endnote 8)

Figure 3: SO_2 Emissions and the Allowance Bank, 1995–2008



Source: EPA, 2009

ed above (see Table 2). Using updated methods to assess ground-level ozone benefits results in total benefits ranging from 75 to 319 percent of those previously predicted (see Table 3). These updated benefits do not include human welfare benefits due to better ecological conditions, such as improved visibility and reduced acidification of lakes and streams.

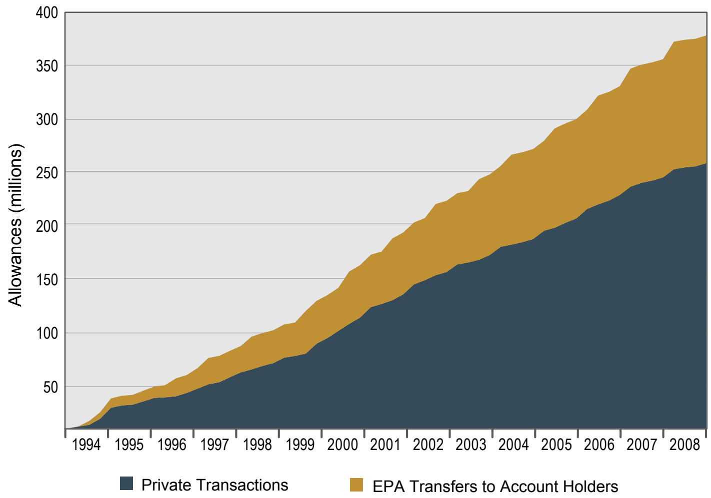
SO_2 Program Compliance

In 2008, all ARP facilities complied with the requirement to hold enough allowances to cover SO_2 emissions. EPA allocated 9.5 million SO_2 allowances under the ARP for 2008. Together with 6.7 million unused allowances carried over (or banked) from prior years, there were 16.2 million allowances available for use in 2008 (see Figure 3). ARP sources emitted approximately 7.6 million tons of SO_2 in 2008, less than the allowances allocated for the year, and far less than the total allowances available (see Figure 3). As a result, between 2007 and 2008 the bank increased by nearly two million allowances to 8.6 million, a 28 percent increase. In 2010, the total number of Title IV allowances allocated annually will drop to 8.95 million and remain statutorily fixed at that annual level.

2008 SO_2 Allowance Market

Figure 4 shows the cumulative volume of SO_2 allowances transferred under the ARP. The figure differentiates between allowances transferred in private transactions and those annually allocated and transferred to source accounts by EPA.

Figure 4: Cumulative SO_2 Allowances Transferred under the ARP (through 2008)



Source: EPA, 2009

Private transactions are indicative of both market interest and use of allowances as a compliance strategy. Of the nearly 379 million allowances transferred since 1994, about 68 percent were traded in private transactions. In December 2001, parties began to use a system developed by EPA to allow online allowance transfers. In 2008, account holders registered over 99 percent of all private allowance transfers through EPA's online transfer system. Allowance transfers are posted and updated daily on <www.epa.gov/airmarkets>.

Figure 5: SO_2 Allowances Transferred under the ARP

Source: EPA, 2009

In 2008, 3,236 private allowance transfers involving approximately 13.9 million allowances of past, current, and future vintages were recorded in EPA's Allowance Management System (AMS). About 5.9 million allowances (42 percent) were transferred in economically significant transactions (i.e., between economically unrelated parties). Transfers between economically unrelated parties are "arm's length" transactions and are considered a better indicator of an active, functioning market than are transactions among the various facility and general accounts associated with a given company. In the majority of all private transfers, allowances were acquired by power companies. Figure 5 shows the annual volume of SO_2 allowances transferred under the ARP (excluding allocations, retirements, and other transfers by EPA) since official recording of transfers began in 1994.

Over the first decade of the Acid Rain Program, allowance prices were stable and significantly lower than projected. When CAIR was proposed in late 2003, allowance prices were influenced by the more stringent CAIR SO_2 cap and new compliance deadline. After CAIR was finalized in March 2005, allowance prices continued to trend upward. CAIR was the most significant driver of the price adjustment that began in 2004 and culminated with prices in the $1,600 range for a short time in December 2005. The Acid Rain SO_2 market essentially became the CAIR SO_2 market.

In 2008, the SO_2 allowance market experienced a 65 percent price decline; the monthly average fell from $509 per ton in January to $179 per ton by December.[9] That decline has continued in 2009, with the allowance price falling to an average of $71 per ton by May. Together with the price decline, the volume of significant transactions fell sharply in 2008. Market observers should not confuse temporary high prices in the market response to major regulatory

Table 4: SO_2 Allowance Market in Brief (close of 2008)

Total Value of the SO_2 Allowance Market	$2.9 billion*
Average Nominal Price	$179 per ton
Total Allowance Volume (Allowable Emissions)	16,227,082
2008 Private Transactions	3,236 transactions moving 13.9 million allowances 42 percent of allowances transferred between economically unrelated parties

* Total value of allowance market is a snapshot based on the average nominal price as of December 2008 ($179/ton) and total allowance volume available for 2008 compliance.

Source: EPA, 2009

How Are Allowances Traded and Tracked?

Once allowances have been auctioned and allocated, utilities can buy, sell, trade, or save them to meet their compliance needs. Along with the utilities that hold allowances for compliance purposes, other actors such as brokers, environmental groups, and private citizens maintain accounts in EPA's AMS. The AMS database records account balances and transaction records, and allows public access to the trading history of each allowance until it is finally retired. EPA does not maintain any sensitive business data, such as the price associated with allowance transfers. Allowance brokers and other market participants generally maintain a market price index (MPI) to track trends in prices over time and provide market signals similar to other commodity markets.

Most allowance transactions take place in the over-the-counter market, where prices are determined by each day's bids and offers, and immediate settlement cash trades are enacted bilaterally or through brokers. Once trading parties agree on a price, they generally complete the transaction using standard contracts developed by trade associations or other market players (see, for example, the sample contract available at <www.environmentalmarkets.org>). EPA provides a list of brokers and environmental groups that may be interested in facilitating trades or in helping parties retire allowances voluntarily (see <www.epa.gov/airmarkets/trading/buying.html>). At some point after a transaction is complete, the account representative of the transferring or selling party will usually register the transfer of allowances with EPA. The representative can submit a paper form or transfer the allowances online using the CAMD Business System (see <www.epa.gov/airmarkets/business/transfer.html>).

Outside of the spot market, utilities and investors have developed a range of more sophisticated structures to manage risk, including forward settlements, options, and swaps. However, these allowance trading strategies generally apply to market participants who have significant interests in allowance holdings or who are active investors in the market; such strategies are not necessary for transferring allowances for basic compliance needs.

changes (more or less regulation), where buyers and sellers are searching for a new equilibrium based on available information they have from consultants and various services, with price volatility. EPA and market analysts have identified these regulatory forces—the CAIR emission caps and compliance deadlines, followed by the rule changes resulting from the July 2008 CAIR court decision—as the primary factor affecting current market conditions in the period from 2004 to 2008 and not inherent volatility in cap and trade programs due to shifts in other variables that influence the market. For further analysis see <www.epa.gov/airmarkets/resource/docs/marketassessmnt.pdf>.

SO_2 Allowance Auction

EPA's 2009 annual ARP allowance auction was held on March 24. The annual auction provides an opportunity for power plants, brokers, and private citizens to buy and sell allowances. Title IV mandates that a limited number of allowances allocable to existing sources be withheld and auctioned. The auctions help ensure that new electric generating plants have a source of allowances beyond those allocated initially to existing units. Proceeds from the auctions are returned to sources in proportion to the allowances withheld.

The auction includes two "vintages" of allowances. Vintage describes the earliest year an allowance may be applied against SO_2 emissions. In addition to year 2009 allowances, the Clean Air Act mandated that EPA auction additional allowances seven years in advance to help provide stability in planning for capital investment. These advance allowances will be usable first in 2016. Complete results of the annual SO_2 Allowance Auction are available at <www.epa.gov/airmarkets/trading/auction.html>.

NO_X

NO_X Emission Reductions

Title IV requires NO_X emission reductions for certain coal-fired EGUs by limiting the NO_X emission rate (expressed in lb/mmBtu). Congress applied these rate-based emission limits based on a unit's boiler type. The goal of the NO_X program is to limit NO_X emission levels from the affected coal-fired boilers so that their emissions are at least 2 million tons less than the projected level for the year 2000 without implementation of Title IV.

Figure 6, on page 8, shows that NO_X emissions from all ARP sources were 3.0 million tons in 2008. This level is 5.1 million tons less than the projected level in 2000 without the ARP, or more than double the Title IV NO_X emission reduction objective. While the ARP was responsible for a large portion of these annual NO_X reductions, programs such as the NO_X Budget Program under EPA's NO_X State Implementation Plan (SIP) Call and other regional and state NO_X emission control programs also contributed significantly to the NO_X reductions achieved by sources in 2008.

Sources Achieved 100 Percent NO_X Compliance in 2008, Using a Variety of NO_X Compliance Plan Options

Standard Limitation. A unit with a standard limit meets the applicable individual NO_X limit prescribed for its boiler type under 40 CFR Parts 76.5, 76.6, or 76.7 (290 units used this option in 2008).

Alternative Emission Limit (AEL). A utility can petition for a less stringent AEL if it properly installs and operates the NO_X emission reduction technology prescribed for that boiler, but is unable to meet its standard limit. EPA determines whether an AEL is warranted based on analyses of emission data and information about the NO_X control equipment (six units used this option in 2008).

Emissions Averaging. Many companies meet their NO_X emission reduction requirements by choosing to become subject to a group NO_X limit, rather than by meeting individual NO_X limits for each unit. The group limit is established at the end of each calendar year. The group rate must be less than or equal to the Btu-weighted group rate units would have had if each had emitted at their standard limit rate (673 units used this option in 2008).

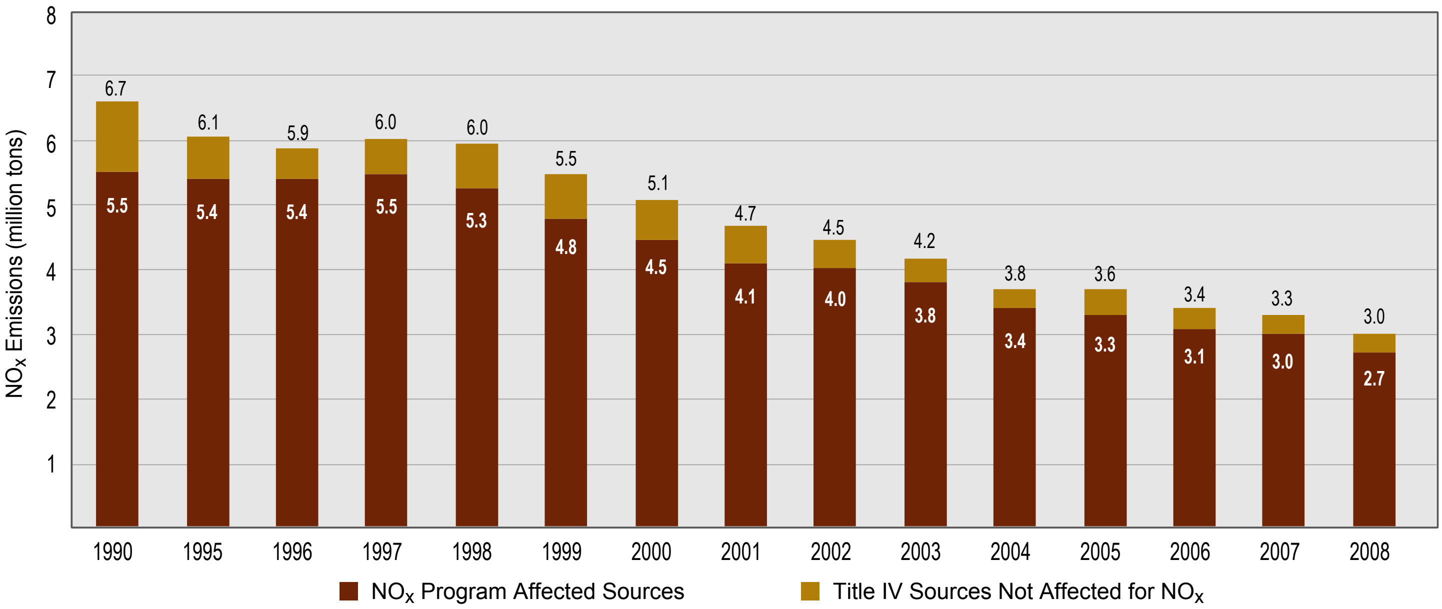
Note: Unit counts do not include those with a retired unit exemption.

From 1995 to 2008, annual NO_X emissions from ARP units dropped by about 3.1 million tons, a net decrease of 51 percent. During this period, forty-two states and the District of Columbia reduced NO_X emissions, while six other states accounted for only about 15,600 tons of increased NO_X emissions.

Seasonal NO_X Control Programs

States subject to EPA's 1998 NO_X SIP Call have achieved significant reductions in ozone season NO_X emissions since the baseline years 1990 and 2000. All of these states have achieved reductions since 1990 as a result of programs implemented under the 1990 Clean Air Act Amendments, with many of them reducing their emissions by more than half since 1990. A significant portion of these decreases in NO_X emissions has been achieved since 2000, largely as a

Figure 6: NO_x Emission Trends for All Acid Rain Program Units, 1990–2008



Source: EPA, 2009

result of reductions under ozone season NO_x trading programs implemented by the OTC, from 1999-2002, and under the NO_x SIP Call, from 2003-2008. For reports about these programs, see <www.epa.gov/airmarkets/progress/progress-reports.html>.

Even with these other programs, further reductions in annual NO_x emissions were achieved in 2008. Possible reasons for this decline could include:

- 8 new selective catalytic reduction systems (SCR) and 7 new selective noncatalytic reduction systems (SNCR) were installed in 2008.
- Sources might have taken advantage of incentives for generation of early action (compliance supplement pool) allowances intended for use under the CAIR annual NO_x program that began in January 2009.

NO_x Compliance

The ARP NO_x Program does not impose a cap on NO_x emissions and does not rely on allowance trading. The ARP NO_x Program, however, provides compliance flexibility achieved through an approach that is designed to maximize NO_x emission reductions and ensure that those reductions are sustained. Under the ARP, EPA allows affected sources to comply by either meeting a unit-specific emission rate or including two or more units in an emission rate averaging plan (see text box on page 7). These options provide affected sources with the flexibility to meet the NO_x emission reduction requirements in the most cost-effective manner. In 2008, all 969 units that were subject to the ARP NO_x Program achieved compliance.

Emission Monitoring and Reporting

The ARP requires regulated sources to measure, record, and report emissions using continuous emission monitoring systems (CEMS) or an approved alternative measurement method. The vast majority of emissions are monitored with CEMS, while the alternatives provide an efficient means of monitoring emissions from the large universe of units with lower overall mass emissions. Table 5 shows the number of units with and without SO_2 CEMS for various fuel types, as well as the amount of SO_2 emissions monitored using CEMS. Although only 32 percent of units use CEMS, 99 percent of all SO_2 emissions from ARP sources are monitored in this fashion.

CEMS and approved alternatives are a cornerstone of the ARP's accountability and transparency. Since the program's inception in 1995, affected sources have met stringent monitoring quality assurance and control requirements, and have reported hourly emission data in quarterly electronic reports to EPA. Using automated software audits, EPA rigorously checks the completeness, quality, and in-

Table 5: Units and SO_2 Emissions Covered by Monitoring Method for the Acid Rain Program

		Number of Units	Percentage of Units	Percentage of SO_2 Emissions
Coal	CEMS	1,055	29.74	98.68
Gas	CEMS	19	0.54	0.03
	Non-CEMS	2,259	63.69	0.06
Oil	CEMS	42	1.18	0.21
	Non-CEMS	159	4.48	0.88
Other	CEMS	12	0.34	0.13
	Non-CEMS	1	0.03	0.00

Note: "Other fuel units" include units that in 2008 combusted primarily wood, waste, or other nonfossil fuel. The total number of units in the table excludes 25 affected units that did not operate in 2008.

Source: EPA, 2009

tegrity of these data. All emission data are available to the public on the Data and Maps web site maintained by EPA's Clean Air Markets Division (CAMD) at <camddataandmaps.epa.gov/gdm/>. The site also provides access to other data associated with emission trading programs, including reports, queries, maps, charts, and file downloads covering source information, emissions, allowances, program compliance, and air quality.

The emission monitoring requirements for the ARP are found in 40 CFR Part 75. Compliance with these provisions is also required for sources participating in the CAIR trading programs.

ECMPS

CAMD recently reengineered the process that the regulated community uses to maintain, evaluate, and submit monitoring plans, quality assurance certifications, and quarterly emission data. An important tool in this effort is the Emissions Collection and Monitoring Plan System (ECMPS). Beginning with reports submitted in April 2009, ECMPS has replaced the processes and multiple software tools used previously for evaluating, submitting, and receiving compliance-related information. Data submitted via ECMPS must meet a basic level of quality. If an evaluation generates a "critical" error, sources are able to submit data to meet the regulatory deadline but must then resolve the errors and resubmit the data. ECMPS also has an expanded set of data validation checks that assist EPA in implementing improved auditing as sources begin to comply with CAIR. ECMPS incorporates the following components:

- A single desktop tool, made available by EPA, for authorized users to import and evaluate their data and submit it to CAMD.
- A new data reporting format based on the flexible Extensible Markup Language (XML) standard.
- A centralized database at CAMD for receiving and maintaining submitted data, which can be accessed directly through the desktop tool.
- Tools and procedures for the quality assurance of data prior to submission, including the consolidation of evaluation results (feedback) into one set.
- The ability to maintain select data outside of the electronic data report.
- New security requirements.

Endnotes

1 Chestnut, L. G., and Mills, D. M. 2005. A fresh look at the benefits and costs of the US Acid Rain Program, *Journal of Environmental Management*, 77(3): 252-266.

2 Pope C.A., Burnett R.T., Thun M.J., Calle E.E., Krewski D., Ito K., and Thurston G.D. 2002. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution, *JAMA*, 287(9):1132-1141.

3 Year 2008$ inflated from $108 billion and $4.384 billion 2000$ using CPI inflation calculator.

4 Laden F., Schwartz J., Speizer F.E., Dockery D.W. 2006. Reduction in fine particulate air pollution and mortality: Extended Follow-up of the Harvard Six Cities Study, *American Journal of Respiratory and Critical Care Medicine*, 173 (2006) 667-672.

5 See EPA's Regulatory Impact Analysis for the 2006 $PM_{2.5}$ National Ambient Air Quality Standards, available at: <www.epa.gov/ttn/ecas/ria.html>.

6 The original air quality estimates were based on a regulatory air quality modeling platform that has been substantially updated since 2005. The updates include (1) major changes to base year and future case emissions and meteorological inputs, (2) a new air quality model with improved chemistry and other scientific features, and (3) new methods for projecting future air quality relative to current measured data. The effects of these improvements on the benefits from the ARP have not been quantified.

7 Valuation includes 3% discount rate for future incidences of premature mortality avoided.

8 **O_3 Mortality, Non-Accidental**

Ito, K., De Leon, S.F., and Lippmann, M. 2005. Associations between ozone and daily mortality: analysis and meta-analysis. *Epidemiology* 16(4): 446-57.

Schwartz, J. 2005. How sensitive is the association between ozone and daily deaths to control for temperature? *American Journal of Respiratory and Critical Care Medicine* 171 (6): 627-31.

Bell, M.L., McDermott, A., Zeger, S.L., Samet, J.M., and Dominici, F. 2004. Ozone and short-term mortality in 95 US urban communities, 1987-2000. *JAMA* 292(19): 2372-8.

O_3 Mortality, All Cause

Levy, J.I., Chemerynski, S.M., and Sarnat, J.A. 2005. Ozone exposure and mortality: an empiric bayes metaregression analysis. *Epidemiology* 16(4): 458-68.

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O_3 Mortality, Cardiopulmonary

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9 Based on the Market Price Index (MPI) that uses trade, bid, and offer price as tracked by CantorCO2e.