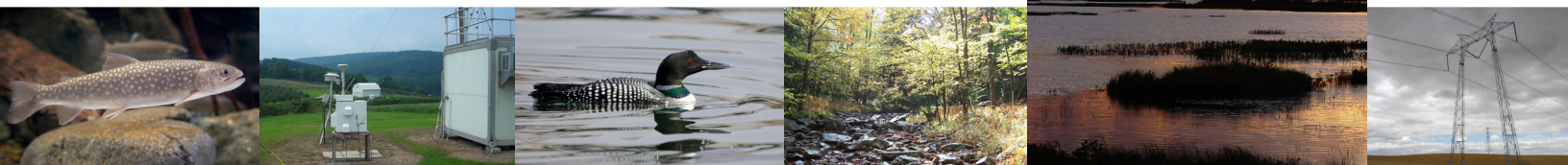


# Acid Rain and Related Programs: 2008 Emission, Compliance, and Market Data



The Acid Rain Program (ARP), established under Title IV of the 1990 Clean Air Act (CAA) Amendments, requires major emission reductions of SO<sub>2</sub> and NO<sub>x</sub>, the primary precursors of acid rain, from the electric power industry. The SO<sub>2</sub> program sets a permanent cap on the total amount of SO<sub>2</sub> that may be emitted by electric generating units (EGUs) in the contiguous United States. The program is phased in, with the final 2010 SO<sub>2</sub> cap set at 8.95 million tons, a level of about one-half of the emissions from the power sector in 1980. NO<sub>x</sub> reductions under the ARP are achieved through a program that applies to a subset of coal-fired EGUs and is closer to a traditional, rate-based regulatory system. Since the program began in 1995, the ARP has achieved significant emission reductions. Table 1 shows that between 2004 and 2008, SO<sub>2</sub> and NO<sub>x</sub> emissions fell significantly, while heat input (a surrogate measure of electricity generation) increased slightly. Most of the recent reductions since 2005 are from early reduction incentives of the Clean Air Interstate Rule (CAIR) covering most eastern states.

Over the next several months, EPA will release a series of reports summarizing progress under the ARP. This first report presents 2008 data on emission reductions, compli-

## At a Glance: ARP Results in 2008

**SO<sub>2</sub> Emissions:** 7.6 million tons

**SO<sub>2</sub> Compliance:** 100%

**SO<sub>2</sub> Allowances:** Banked allowances increased by almost 2 million from 2007 levels

**SO<sub>2</sub> Allowance Prices:** Nominal allowance prices declined sharply during the year, from a monthly average of \$509/ton in January to \$179/ton in December

**NO<sub>x</sub> Emissions:** 3.0 million tons

**NO<sub>x</sub> Compliance:** 100%

ance results, and SO<sub>2</sub> allowance prices. Future reports will evaluate progress under the ARP in 2008 by analyzing emission reductions, reviewing compliance results and market activity, and comparing changes in emissions to changes in acid deposition and surface water chemistry. For more information on the ARP, please visit: <http://www.epa.gov/airmarkets/progsregs/arp/index.html>.

**Table 1: SO<sub>2</sub>, NO<sub>x</sub>, and Heat Input Trends in Acid Rain Program Units, by Fuel Type**

Fuel Type	2004			2005			2006			2007			2008		
	SO <sub>2</sub>	NO <sub>x</sub>	HI	SO <sub>2</sub>	NO <sub>x</sub>	HI	SO <sub>2</sub>	NO <sub>x</sub>	HI	SO <sub>2</sub>	NO <sub>x</sub>	HI	SO <sub>2</sub>	NO <sub>x</sub>	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 generation 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

## SO<sub>2</sub> Emission Reductions

The SO<sub>2</sub> requirements under the ARP apply to EGUs, fossil fuel-fired combustors that serve a generator that provides electricity for sale. The vast majority of ARP SO<sub>2</sub> emissions result from coal-fired EGUs, although the program also applies to oil and gas units.

As Figure 1 shows, ARP units have reduced annual SO<sub>2</sub> emissions by 56 percent compared with 1980 levels and 52 percent compared with 1990 levels. Sources emitted 7.6 million tons of SO<sub>2</sub> 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.

Reductions in SO<sub>2</sub> 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<sub>2</sub> emissions from all sources since 1980. National SO<sub>2</sub> 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](http://www.epa.gov/ttn/chief/trends)).

The states with the highest emitting sources in 1990 have generally seen the greatest SO<sub>2</sub> reductions under the ARP (see Figure 2). Most of these states are upwind of the ar-

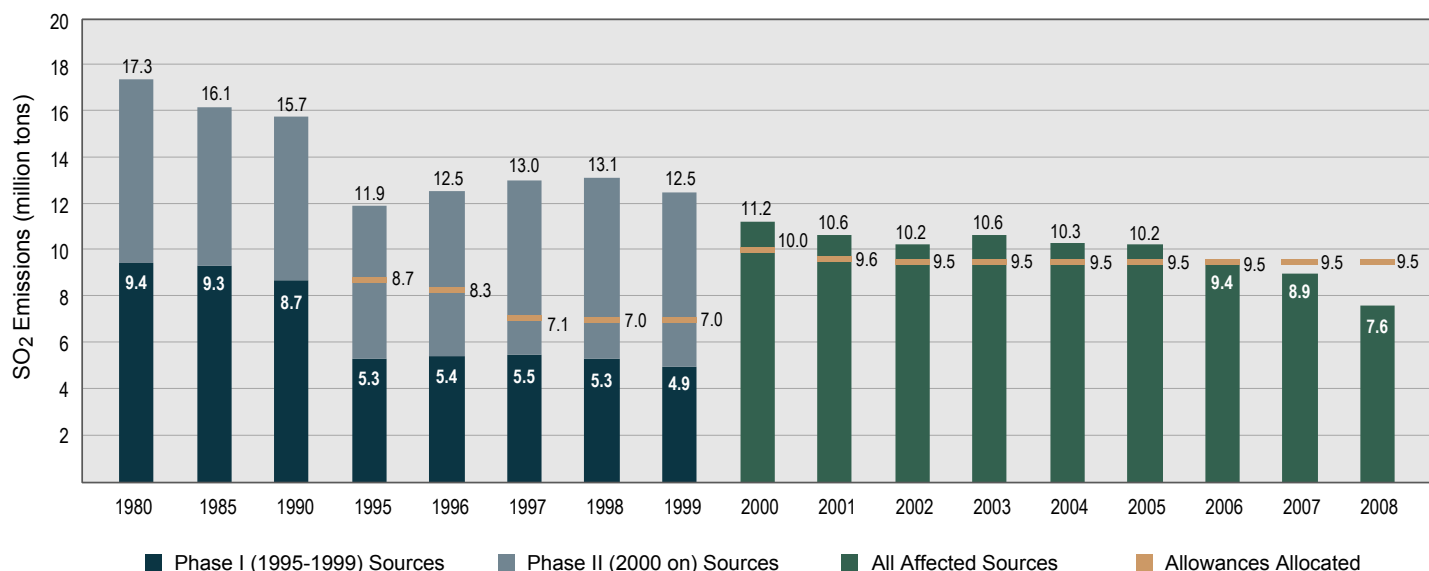
**Table 2: Origin of 2008 Allowable SO<sub>2</sub> Emission Levels**

Type of Allowance Allocation	Number of Allowances	Explanation of Allowance Allocation Type
Initial Allocation	9,191,897	Initial allocation is the number of allowances granted to EGUs based on the product of their historical utilization and emission rates specified in the Clean Air Act.
Allowance Auction	250,000	The allowance auction provides allowances to the market that were set aside in a Special Allowance Reserve when the initial allowance allocation was made.
Opt-in Allowances	106,497	Opt-in allowances are provided to units entering the program voluntarily. There were 20 opt-in units in 2008.
Total 2008 Allocation	9,548,394	
Total Banked Allowances	6,678,688	Banked allowances are those allowances accrued in a facility's account from previous years, which can be used for compliance in 2008 or any future year.
Total 2008 Allowable Emissions	16,227,082	

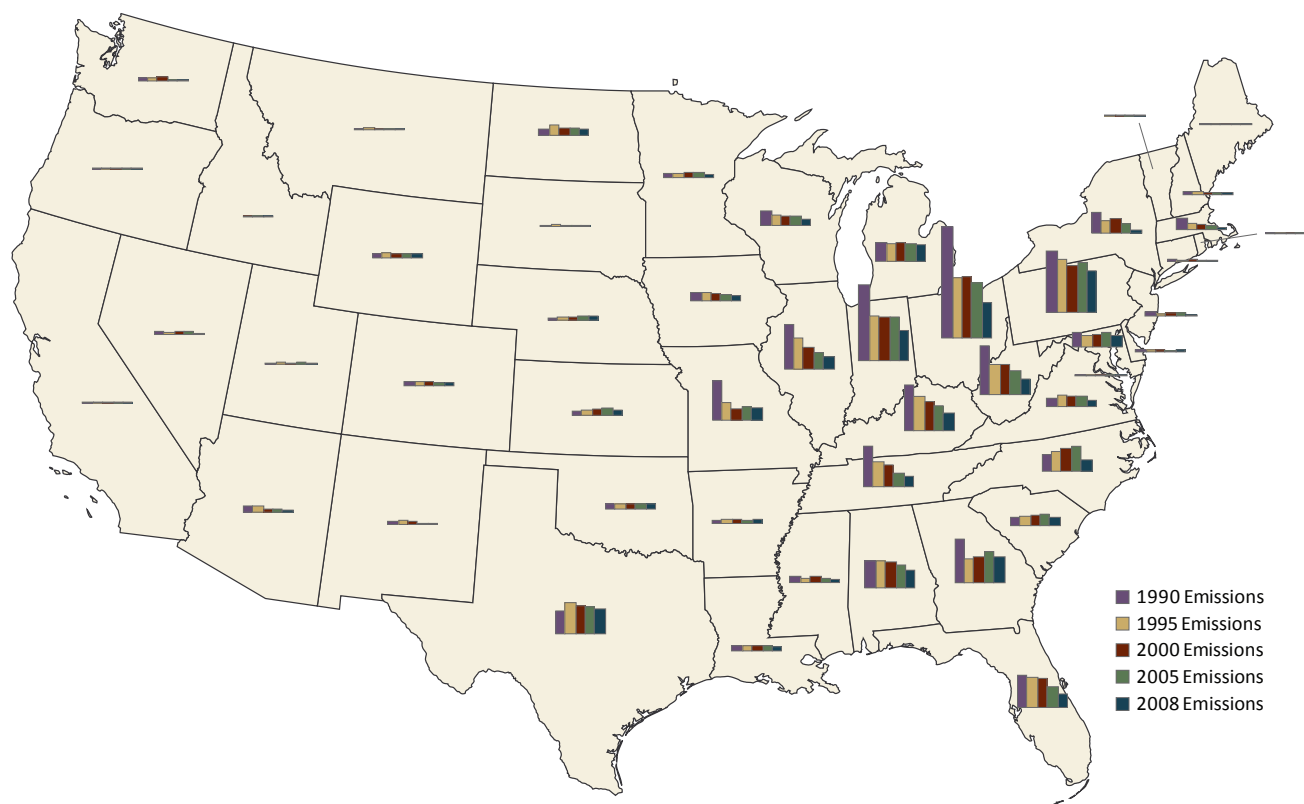
Notes: Total banked allowances are adjusted from the 2007 Progress Report to account for additional allowance deductions made after the 2007 reconciliation was completed.

Source: EPA, 2009

**Figure 1: SO<sub>2</sub> Emissions from Acid Rain Program Sources, 1980 - 2008**



Source: EPA, 2009

Figure 2: State-by-State SO<sub>2</sub> Emission Levels for Acid Rain Program Sources, 1990-2008

Scale: Largest bar equals 2.2 million tons of SO<sub>2</sub> emissions in Ohio, 1990.

Source: EPA, 2009

as 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<sub>2</sub> 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<sub>2</sub> in each of these states.

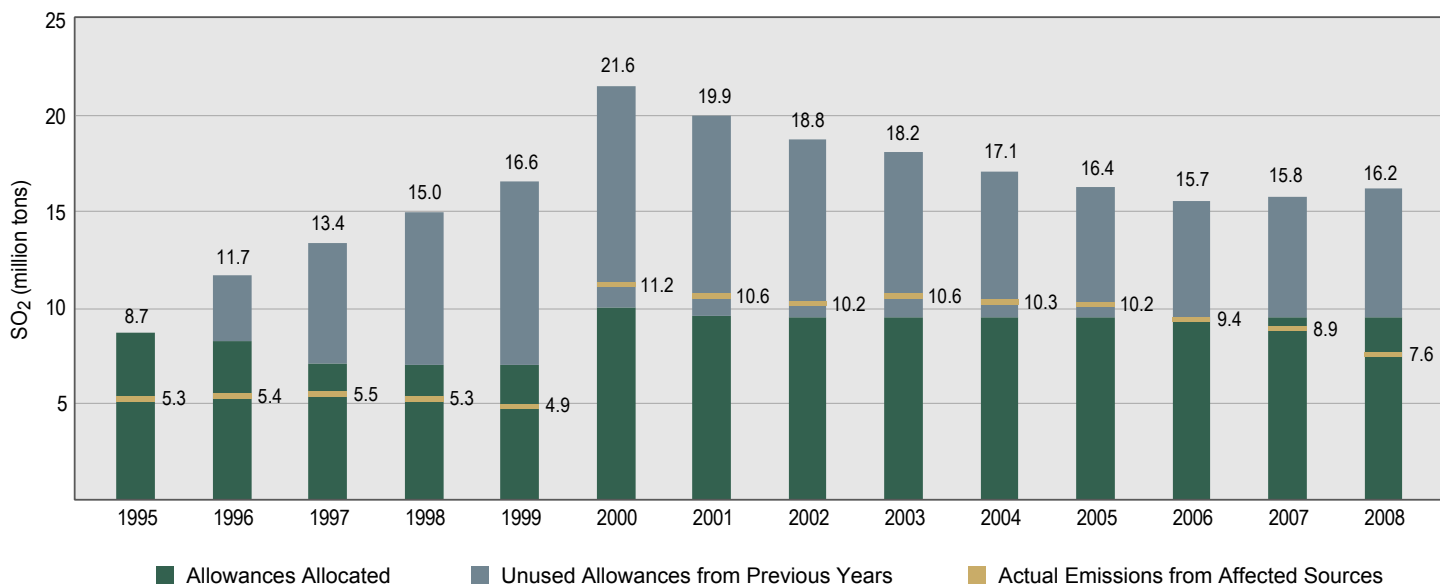
From 1990 to 2008, annual SO<sub>2</sub> emissions in 38 states and the District of Columbia fell by a total of approximately 8.2 million tons. In contrast, annual SO<sub>2</sub> emissions increased by a total of 79,309 tons in 10 states from 1990 to 2008. The seven states with the greatest reductions 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.

### SO<sub>2</sub> Program Compliance

For 2008, EPA allocated 9.5 million SO<sub>2</sub> allowances under the ARP (see Table 2). 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. ARP sources emitted approximately 7.6 million tons of SO<sub>2</sub> in 2008, less than the allowances allocated for the year, and far less than the total allowances available (see Figure 3). 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.

Table 2 explains in more detail the origin of the allowances that were available in 2008, and Table 3 shows how those allowances were used. Approximately 7.6 million allowances were deducted from sources' accounts in 2008 to cover emissions. From 2007 to 2008, the number of banked allowances increased by nearly two million allowances to 8.6 million, a 28 percent increase. In 2008, all ARP facilities complied with the requirement to hold enough allowances to cover SO<sub>2</sub> emissions.

**Figure 3: SO<sub>2</sub> Emissions and the Allowance Bank, 1995-2008**



Source: EPA, 2009

**Table 3: SO<sub>2</sub> Allowance Reconciliation Summary, 2008**

Total Allowances Held (1995 - 2008 vintages)	16,227,082
Affected Facility Accounts	12,210,477
Other (General and Non-Affected Facility Accounts)	4,016,605
Allowances Deducted*	7,602,693
Penalty Allowance Deductions ( 2009 Vintage)	0
Banked Allowances	8,624,389
Affected Facility Accounts	4,607,784
Other (General and Non-Affected Facility Accounts)	4,016,605

\* Includes 3,315 allowances deducted from opt-in sources for reduced utilization. Additionally, allowances deducted for emissions are about 14,000 tons less than the total emissions used elsewhere in this report, which reflect data reported as of July 1, 2009. This is a result of rounding differences, any changes in reported emission data after reconciliation, and resolution of petitions, including emissions for one facility (WH Zimmer in OH) that has not been reconciled due to a monitoring petition. When this facility is reconciled the number of allowances deducted will go up and the amount of banked allowances will decrease.

Source: EPA, 2009

## 2008 SO<sub>2</sub> Allowance Market

In 2008, the SO<sub>2</sub> allowance market experienced a 65% price decline; the monthly average price fell from \$509 per ton in January to \$179 per ton by December (see Figure 4). That decline has continued in 2009, falling to \$71/ton by May. ARP reports released in the coming months will analyze allowance market activity in more detail.

**Figure 4: Average Monthly SO<sub>2</sub> Allowance Price, August 1994 - May 2009**



Source: CantorCO2e Market Price Index, 2009

## NO<sub>x</sub> Emission Reductions

Title IV requires NO<sub>x</sub> emission reductions for certain coal-fired EGUs by limiting the NO<sub>x</sub> emission rate (expressed in lb/mmBtu). Congress applied these rate-based emission limits based on a unit's boiler type (see Table 4). The goal of the NO<sub>x</sub> program is to limit NO<sub>x</sub> 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 5 shows that NO<sub>x</sub> 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<sub>x</sub> emission reduction objective. While the ARP was responsible for a large portion of these annual NO<sub>x</sub> reductions, other programs—such as the Ozone Transport Commission (OTC), the NO<sub>x</sub> Budget Program under EPA's NO<sub>x</sub> State Implementation Plan (SIP) Call, and other regional and state NO<sub>x</sub> emission control programs—also contributed significantly to the NO<sub>x</sub> reductions achieved by sources in 2008.

From 1995 to 2008, annual NO<sub>x</sub> emissions from ARP units dropped by about 3.1 million tons, a net decrease of 51 percent. Forty-two states and the District of Columbia reduced NO<sub>x</sub> emissions during this period versus six states that accounted for only about 15,600 tons of increased NO<sub>x</sub> emissions during the same period (see Figure 6).

## NO<sub>x</sub> Compliance

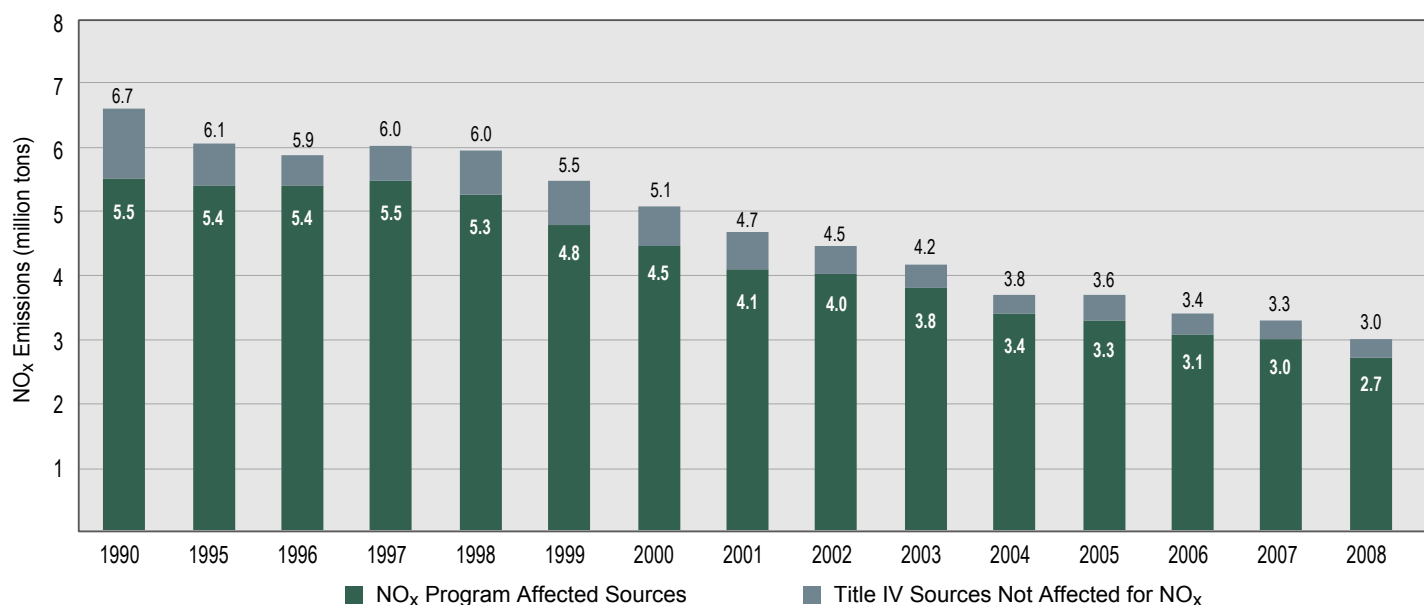
The ARP NO<sub>x</sub> Program does not impose a cap on NO<sub>x</sub> emissions and does not rely on allowance trading. The program allows affected sources to comply either by meeting a unit-specific emission rate or by including two or more units in an emission rate averaging plan. These options provide af-

**Table 4: NO<sub>x</sub>-Affected Title IV Units by Boiler Type and NO<sub>x</sub> Emission Limit**

Coal-Fired Boiler Type	Title IV Standard NO <sub>x</sub> Emission Limits (lb/mmBtu)	Number of Units
Phase I Group 1 Tangentially Fired	0.45	133
Phase I Group 1 Dry Bottom, Wall-fired	0.50	107
Phase II Group 1 Tangentially Fired	0.40	300
Phase II Group 1 Dry Bottom, Wall-fired	0.46	294
Cell Burners	0.68	37
Cyclones > 155 MW	0.86	54
Wet Bottom > 65 MW	0.84	20
Vertically Fired	0.80	24
<b>Total All Units</b>		<b>969</b>

Source: EPA, 2009

**Figure 5: NO<sub>x</sub> Emission Trends for All Acid Rain Program Units, 1990-2008**

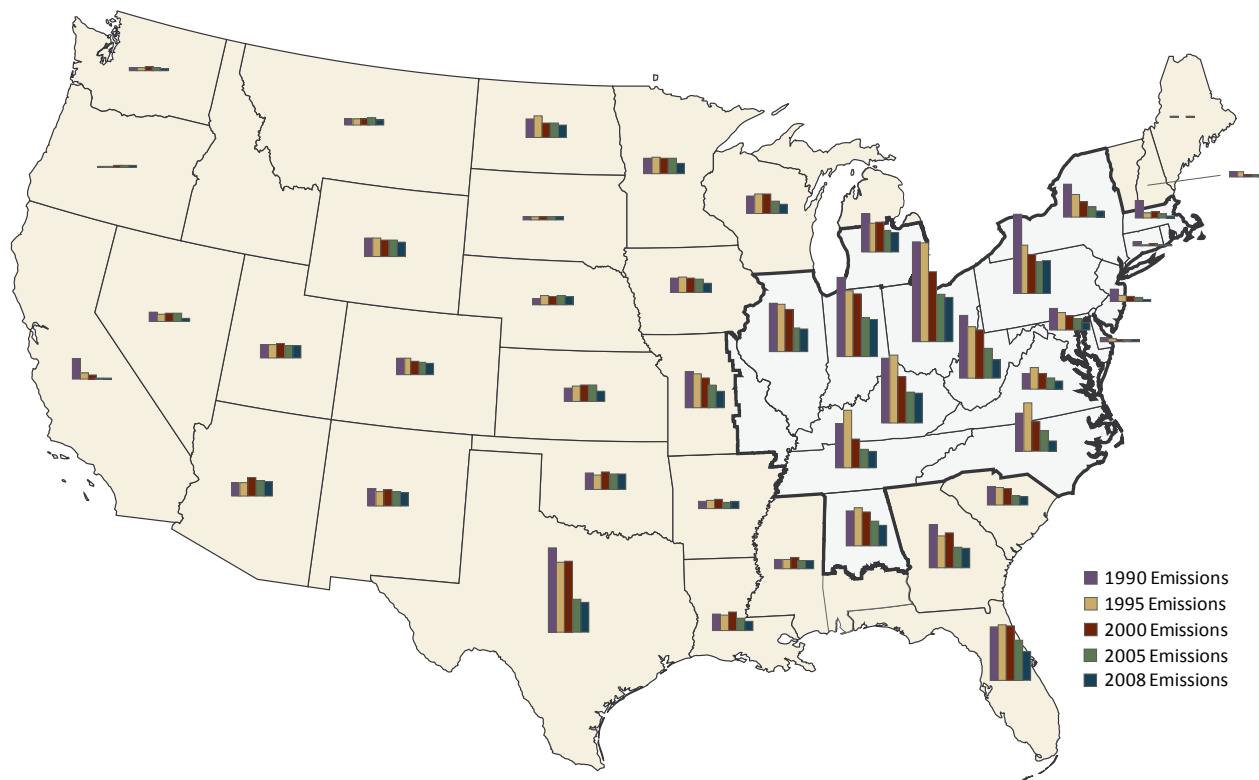


Source: EPA, 2009

affected sources with the flexibility to meet the NO<sub>x</sub> emission reduction requirements in the most cost-effective manner.

In 2008, all 969 units that were subject to the ARP NO<sub>x</sub> Program achieved compliance.

**Figure 6: State-by-State NO<sub>x</sub> Emission Levels for Acid Rain Program Sources, 1990 - 2008**



Scale: Largest bar equals 500,000 tons of NO<sub>x</sub> emissions in Ohio, 1990.

Note: Area shaded in gray represents the NO<sub>x</sub> Budget Program geographic region.

Source: EPA, 2009