

# The NO<sub>x</sub> Budget Trading Program: 2008 Highlights



The NO<sub>x</sub> Budget Trading Program (NBP) was a market-based cap and trade program created to reduce the regional transport of emissions of nitrogen oxides (NO<sub>x</sub>) from power plants and other large combustion sources that contribute to ozone nonattainment in the eastern United States. NO<sub>x</sub> is a major precursor to the formation of ground-level ozone, a pervasive air pollution problem in many areas in the East. The NBP was designed to reduce NO<sub>x</sub> emissions during the warm summer months, referred to as the ozone season, when ground-level ozone concentrations are highest.

The NBP was established through the NO<sub>x</sub> State Implementation Plan (SIP) Call, promulgated in 1998. All 20 affected states and the District of Columbia (DC) chose to meet mandatory NO<sub>x</sub> SIP Call reductions primarily through participation in the NBP. From the beginning of program implementation in 2003 to 2008, the NBP dramatically reduced NO<sub>x</sub> emissions from power plants and industrial sources during the summer months, contributing significantly to improvements in ozone air quality in the eastern United States. In 2009, the NBP was replaced by the Clean Air Interstate Rule (CAIR) NO<sub>x</sub> ozone season trading program, which required emission reductions from affected sources in an expanded geographic area and went into effect May 1, 2009.

From May to September 2009, the U.S. Environmental Protection Agency (EPA) released three reports detailing progress under the NBP. This final document highlights the key results from the previous reports and discusses the transition from the NBP to the CAIR NO<sub>x</sub> ozone season program. These reports can be accessed at [www.epa.gov/airmarkets/progress/nbp08.html](http://www.epa.gov/airmarkets/progress/nbp08.html).

For more information on the NBP, please visit: [www.epa.gov/airmarkets/progress/nox/sip.html](http://www.epa.gov/airmarkets/progress/nox/sip.html). Detailed emission results and other facility and allowance data are also publicly available on EPA's Data and Maps Web site at [camddataand-maps.epa.gov/gdm](http://camddataand-maps.epa.gov/gdm). To view emission and other facility information in an interactive file format using Google Earth or a similar three-dimensional platform, go to [www.epa.gov/airmarkets/progress/interactivemapping.html](http://www.epa.gov/airmarkets/progress/interactivemapping.html).



## Overview of the NO<sub>x</sub> Budget Trading Program

Over the past six ozone seasons, the NBP significantly lowered NO<sub>x</sub> emissions from affected sources, contributing to improvements in regional air quality across the Midwest, Northeast, and Mid-Atlantic. Cap and trade programs such as the NBP and the Acid Rain Program (ARP) set a cap on overall regional emissions and allocate allowances to each affected source. Each allowance authorizes a certain number of emissions—in this case, one ton. This approach provides individual sources with flexibility in how they comply with emission limits. Sources may sell or bank (save) excess allowances if they reduce emissions and have more than they need, or purchase allowances if they are unable to keep emissions below their allocated budget.

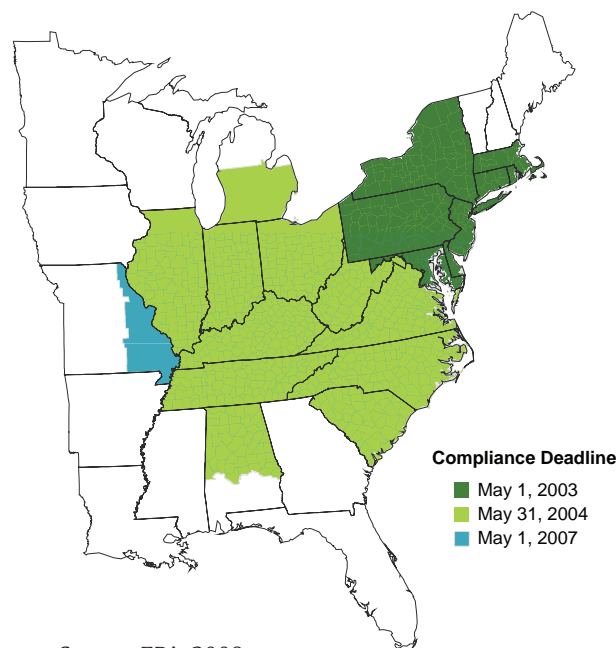
As a group, the participating sources cannot exceed the cap and each individual source cannot emit more than the allowances it holds for compliance. The cap level is intended to protect public health and the environment and to sustain that protection into the future, regardless of growth in the affected sector. The cap also lends stability and predictability to the allowance trading market and provides regulatory certainty to affected sources. Cap and trade programs like the NBP and the ARP have proven highly effective in reducing emissions from multiple sources while meeting environmental goals and improving human health.

## Key Components of the NBP

The NBP was an ozone season (May 1 to September 30) cap and trade program for electric generating units (EGUs) and large industrial combustion sources, primarily boilers and turbines. The program had several important features:

- **Affected States and Compliance Dates:** Compliance with the NO<sub>x</sub> SIP Call was scheduled to begin on May 1, 2003, for the full ozone season for 20 states and the District of Columbia. However, litigation delayed full implementation for 12 states not previously in the Ozone Transport Commission's (OTC) NO<sub>x</sub> Budget Program. The OTC states (Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Pennsylvania, Rhode Island, and the District of Columbia) adopted the original compliance date of May 1, 2003, to transition to the NO<sub>x</sub> SIP Call (see Figure 1). Eleven states not previously in the OTC NO<sub>x</sub> Budget Program (Alabama, Illinois, Indiana, Kentucky, Michigan, North Carolina, Ohio, South Carolina, Tennessee, Virginia, and West Virginia) began compliance on May 31, 2004, one month into the normal ozone season. Finally, Missouri began compliance with the program on May 1, 2007.

Figure 1: NO<sub>x</sub> SIP Call Program Implementation



Source: EPA, 2009

- **Regionwide Cap:** The cap was the sum of state emission budgets that EPA established under the NO<sub>x</sub> SIP Call to help states meet their air quality goals to protect human health and the environment.
- **Limited Allowances:** Authorizations to emit, known as allowances, were allocated to affected sources based on state trading budgets. The NO<sub>x</sub> allowance market enabled sources to trade (buy and sell) allowances throughout the year.
- **Compliance Alternatives:** Sources must surrender allowances to cover emissions while having the flexibility to lower allowance needs by adding emission controls, replacing existing controls with more advanced technologies, optimizing existing controls, or switching fuels.
- **Stringent, Complete Monitoring:** To accurately monitor and report emissions, sources used continuous emission monitoring systems (CEMS) or other approved monitoring methods under EPA's stringent monitoring requirements (40 CFR, Part 75).
- **Compliance Determination:** At the end of every ozone season, each source had to surrender sufficient allowances to cover its ozone season NO<sub>x</sub> emissions, with one allowance required for each ton of NO<sub>x</sub> emissions. This process is called annual reconciliation. Progressive flow control provisions, which took



effect when the size of the allowance bank exceeded 10 percent of the regional budget for the subsequent year, meant that EPA could require a certain portion of banked allowances to be deducted at a ratio of two allowances per ton of emissions.

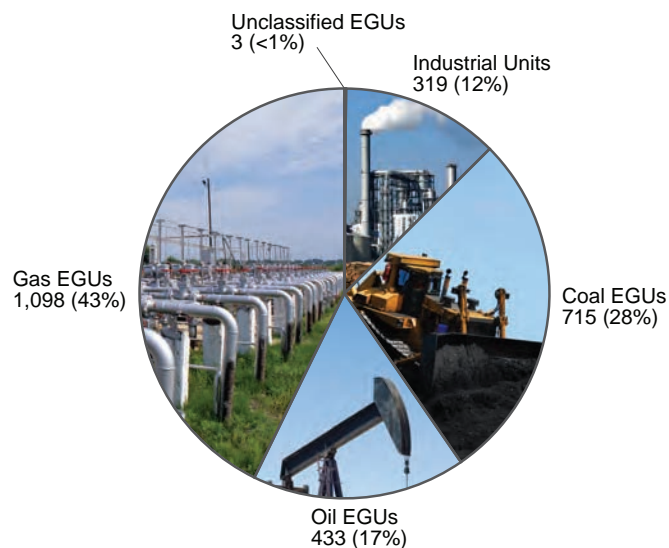
- **Automatic Penalties:** If a source did not have enough allowances to cover its emissions, EPA automatically deducted allowances from the following year's allocation at a 3:1 ratio. Units out of compliance in 2008 had to surrender 2009 CAIR NO<sub>x</sub> ozone season allowances.
- **Allowance Market and Banking:** If a source had excess allowances because it reduced emissions beyond required levels, it could sell the unused allowances or bank (save) them for use in a future ozone season. On January 1, 2009, EPA transferred NBP banked allowances for use in the CAIR NO<sub>x</sub> ozone season program.

### Key Results

**Affected Units:** There were 2,568 affected units under the NBP in 2008, including some units that may not have operated nor had emissions during the 2008 ozone season:

- 88 percent of all regulated NBP units were EGUs (see Figure 2).

**Figure 2: Number of Units in the NBP by Type in 2008**



Notes:

- The three "unclassified" units represent units in long-term shut-down or other non-operating status that remained identified as affected units under the NBP and that had not retired prior to the 2008 ozone season.
- Percentages add up to more than 100 due to rounding.

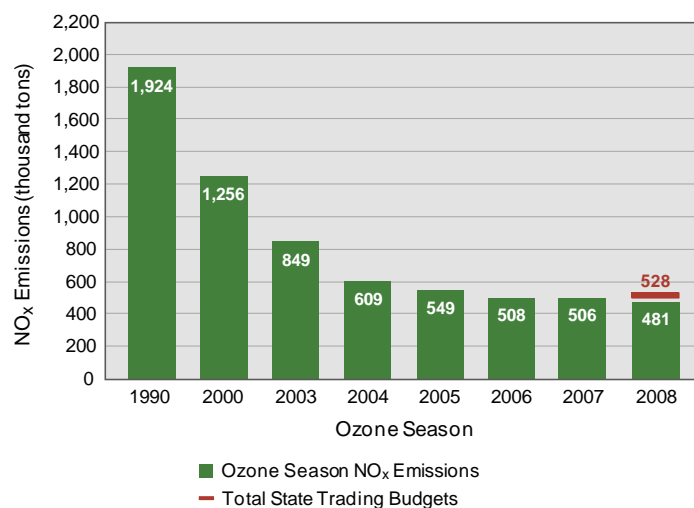
Source: EPA, 2009

- The program also applied to large industrial units that produced electricity or steam primarily for internal use. Examples of these units are boilers and turbines at heavy manufacturing facilities.

**Ozone Season Emissions:** Since the program began in 2003, the NBP has successfully reduced ozone season NO<sub>x</sub> emissions throughout the region. Figure 3 and Appendix A show that in 2008, NBP ozone season NO<sub>x</sub> emissions totaled approximately 481,420 tons and were:

- 9 percent below 2008 cap.
- 62 percent lower than in 2000 (before implementation of the NBP).
- 75 percent lower than in 1990 (before implementation of the 1990 Clean Air Act Amendments).

**Figure 3: Ozone Season NO<sub>x</sub> Emissions from All NBP Sources**



Notes:

- Data reflect full ozone season emissions in all years for all states. The year 2000 baseline value has been adjusted to correct a misprint in Figure 5 of the 2007 NBP report.
- The 2008 total state trading budgets include opt-in allowances, where applicable (New York, Ohio, and West Virginia).

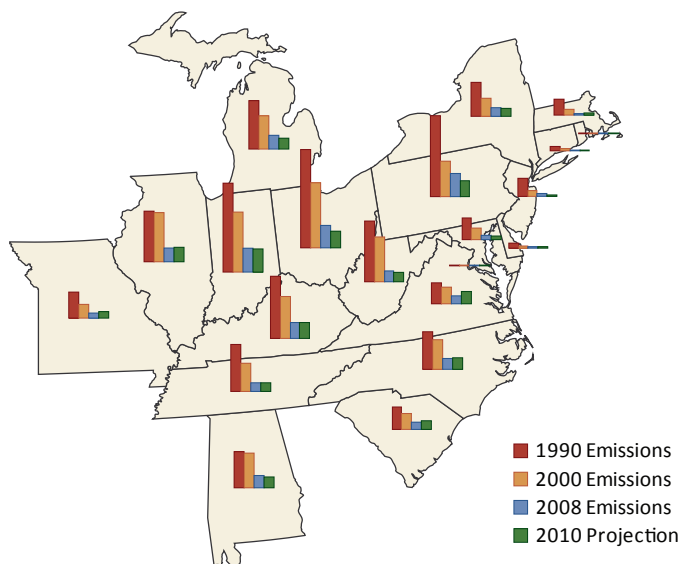
Source: EPA, 2009



**State-by-State NO<sub>x</sub> Reductions:** Ozone season NO<sub>x</sub> emissions decreased from levels in the baseline years in all states that participated in the NBP (see Figure 4):

- Fourteen states and the District of Columbia had emissions below their allowance budgets.

**Figure 4: State-level Ozone Season NO<sub>x</sub> Emissions from NBP to CAIR, 1990-2010**



Scale: Largest bar equals 241,000 tons of NO<sub>x</sub> emissions in Ohio, 1990.

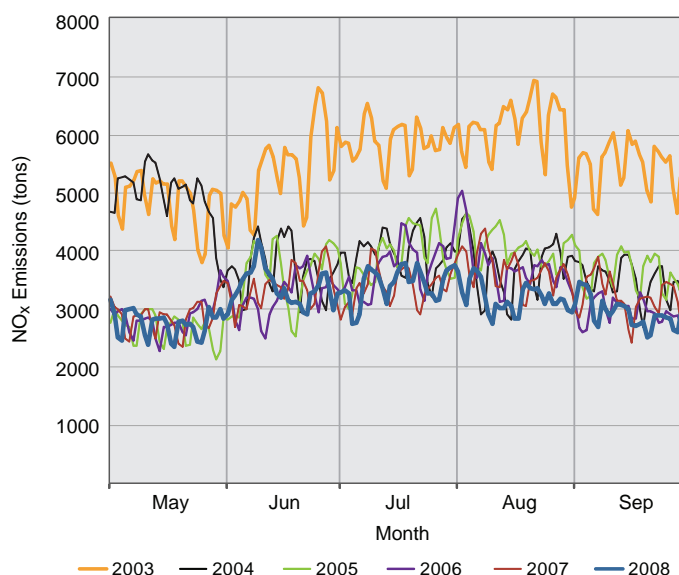
Note: Projected emissions in 2010 represent estimated reductions due to the implementation of CAIR.

Source: EPA, 2009

**High Electric Demand Days:** Even with seasonal NO<sub>x</sub> reductions, periods of hot weather and related high electricity demand often elevate peak NO<sub>x</sub> emissions on a given day:

- During the 2008 ozone season, emission levels on peak demand days were lower than those seen in previous years (see Figure 5).
- The average NO<sub>x</sub> emission rate for the 10 highest electric demand days (as measured by megawatt hours of generation) consistently fell every year of the NBP.

**Figure 5: Comparison of Ozone Season Daily NO<sub>x</sub> Emissions for All NBP Units, 2003-2008**



Note: The relatively high May 2004 daily emissions represent the delayed May 31st compliance date that year for non-OTC states.

Source: EPA, 2009



**Compliance:** Through a wide range of pollution control strategies, sources achieved nearly 100 percent compliance in 2008:

- Only 2 units (out of 2,568 units) were out of compliance by a total of 63 tons, and 189 allowances were retired as a penalty.
- Continuous trend of near-perfect compliance since start of program in 2003.

**Allowances:** Prices and activity were down in 2008 but there is still a substantial bank and an active market:

- 28 percent price decline in 2008, from an average price of \$825 per ton in January to \$592 per ton in November.
- Market observers should not confuse temporary price fluctuation in response to major regulatory changes (more or less regulation) with price volatility.
- 275,367 unused NBP allowances transferred for future use under CAIR.

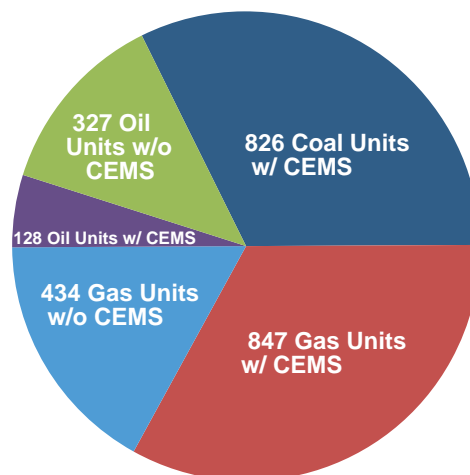
**Continuous Emission Monitoring Systems:** Although many NBP units with low levels of emissions did not have to use CEMS, the vast majority—over 99 percent—of the NO<sub>x</sub> emissions under the NBP were measured by CEMS (see Figures 6 and 7):

- About 70 percent of NBP units used CEMS in 2008, including 100 percent of coal-fired units.

**Controls:** Sources could select from a variety of compliance options to meet NBP emission reduction targets, including installing control technologies, optimizing existing controls, switching fuels, retiring units, and reducing output:

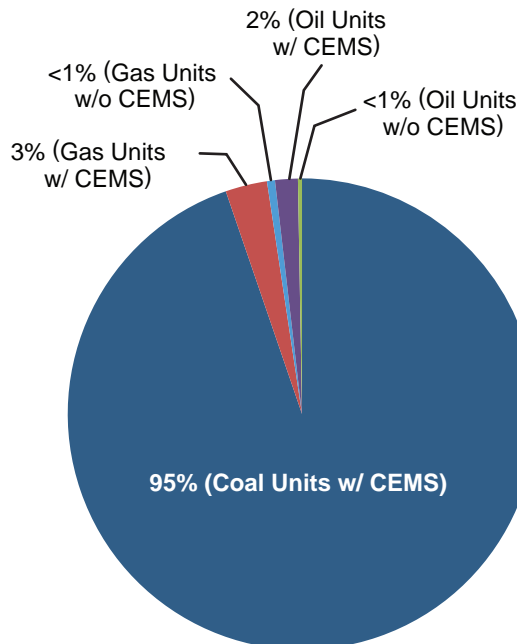
- Average NO<sub>x</sub> emission rate for all units has dropped by 45 percent since 2003.
- 70 percent of NBP units have NO<sub>x</sub> controls; they produced 96 percent of megawatt hour output in 2008.

**Figure 6: Monitoring Methodology for the NBP by Number of Units in 2008**



Source: EPA, 2009

**Figure 7: Monitoring Methodology for the NBP by Ozone Season NO<sub>x</sub> Emissions in 2008**



Notes:

- The 2,562 units represented in Figures 6 and 7 are the same as in Figure 2 of this report, excluding the three unclassified units and three other units, all of which reported no emissions in 2008.
- Percentages add up to more than 100 due to rounding.

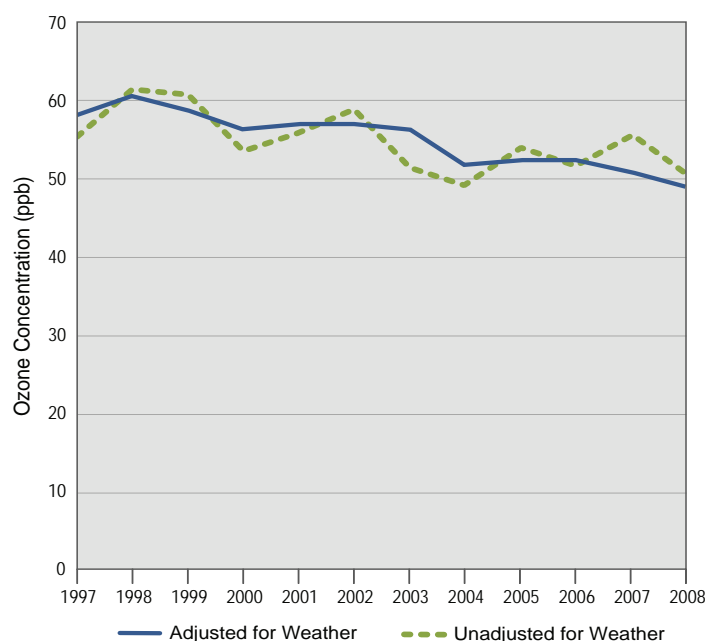
Source: EPA, 2009



**Ozone:** Ground-level ozone has decreased since implementation of the NBP in 2003 (see Figure 8):

- Analyses of ozone trends using various metrics show regionwide ozone reductions ranging from 10-14 percent in the NBP region (in 2003, EGUs throughout the eastern United States plus large industrial sources in the NBP region were responsible for 21 percent of ozone season NO<sub>x</sub> emissions in the eastern United States).
- There is a strong association between areas with the greatest reductions in NO<sub>x</sub> emissions and downwind sites exhibiting the greatest improvements in ozone.

**Figure 8: Seasonal Average 8-Hour Ozone Concentrations in the NBP Region, 1997-2008**



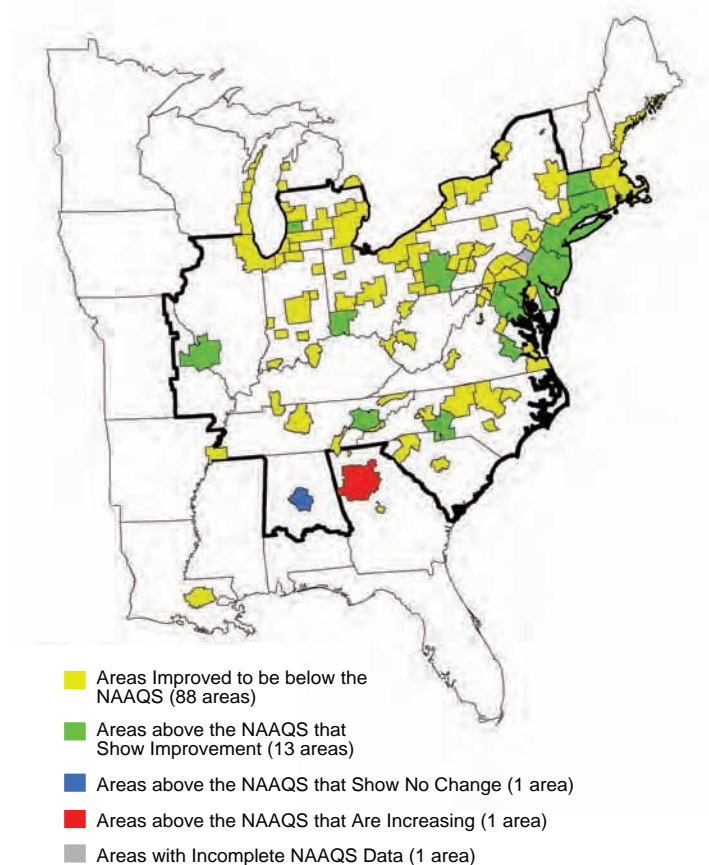
Note: Data presented in this figure are averages of 8-hour daily maximum ozone concentrations during the ozone season for AQS and CASTNET sites within the NBP region.

Source: EPA, 2009

**Nonattainment Areas:** Based on 2006-2008 air monitoring data, ozone air quality improved in almost all of the 104 areas in the eastern United States designated to be in nonattainment for the 1997 8-hour NAAQS:

- 88 areas (85 percent) now have ozone air quality that is better than the level of the 1997 standard (see Figure 9).
- 13 areas continue to exceed the standard but have experienced an average of 10 percent improvement in ozone.
- In total, over 103 million Americans in eastern counties that were out of attainment in 2004 are now living with cleaner air.
- Given that the majority of relevant NO<sub>x</sub> emission reductions occurring after 2003 are attributable to the NBP, it is clear that the NBP is the most significant contributor to these improvements in ozone air quality.

**Figure 9: Changes in Ozone Nonattainment Areas in the East, 2001-2003 (Original Designations) versus 2006-2008**



Note: States in the NBP region are shown inside the black boundary line.

Source: EPA, 2009



**Human Health Benefits:** Studies continue to show a significant link between exposure to air pollution, particularly PM<sub>2.5</sub> and ozone, adverse health effects including respiratory and cardiovascular effects, and premature death:

- NO<sub>x</sub> reductions due to the NBP have led to reductions in ozone and PM<sub>2.5</sub> that are estimated to have saved 580-1,800 lives in 2008.

**Ecosystem Protection:** Changes in ozone and nitrate concentrations due to the NBP have contributed to improvements in ecosystems in the East:

- *Ozone*

The eastern United States has experienced a decrease in areas with significant ozone damage

to seven ozone-sensitive tree species. Ozone has a strong effect on the health of many plants and can increase their susceptibility to disease, insects, fungus, and other environmental stresses, such as harsh weather.

- *Nitrate*

There has been a 33 percent reduction in total ambient nitrate concentrations in the East. Nitrate deposition can be harmful to sensitive ecosystems, vegetation, and water bodies by causing acidification, eutrophication, changes in biological communities, and an increased sensitivity to changes in the environment.







## Clean Air Interstate Rule

CAIR was issued on March 10, 2005, in order to build on the emission reductions under the NBP and the ARP. The rule was designed to permanently lower emissions of SO<sub>2</sub> and NO<sub>x</sub> in the eastern United States. CAIR, as promulgated, was designed to help states address ozone nonattainment and attain the NAAQS for PM<sub>2.5</sub> by reducing transported precursors, SO<sub>2</sub> and NO<sub>x</sub>. CAIR is also intended to improve visibility in Class 1 areas, including national parks, monuments, and wilderness areas. To do this, it created three separate compliance programs: an annual NO<sub>x</sub> program, an ozone season NO<sub>x</sub> program, and an annual SO<sub>2</sub> program.

Each of the three programs uses a two-phased approach, with declining emission caps in each phase. The first phase began in 2009 for the NO<sub>x</sub> annual and NO<sub>x</sub> ozone season programs, and will start in 2010 for the SO<sub>2</sub> annual program. The rule also establishes a second phase for all three programs beginning in 2015. Similar to the NO<sub>x</sub> SIP Call, CAIR gave affected states NO<sub>x</sub> emission budgets and the flexibility in their state implementation plans (SIPs) to reduce emissions using a strategy that best suits their circumstances, including EPA-administered, regional cap and trade programs as one option.

All 28 states and the District of Columbia chose to be part of the EPA-administered regional CAIR trading programs. Monitoring and reporting according to EPA's stringent regulations for the NO<sub>x</sub> programs began in 2008; monitoring and reporting for SO<sub>2</sub> began in 2009.

### Litigation and CAIR Replacement Rule

On July 11, 2008, the U.S. Court of Appeals for the D.C. Circuit issued a ruling vacating CAIR in its entirety. EPA and other parties requested a rehearing, and on December 23, 2008, the Court revised its decision and remanded CAIR to EPA without vacatur. This ruling leaves CAIR and the CAIR Federal Implementation Plans (FIPs)—including the CAIR trading programs—in place until EPA issues new rules to replace CAIR.

While the court did not impose a deadline by which EPA must issue the replacement rules, EPA estimates that development and finalization of replacement rules could take about two years. EPA is committed to issuing rules to re-

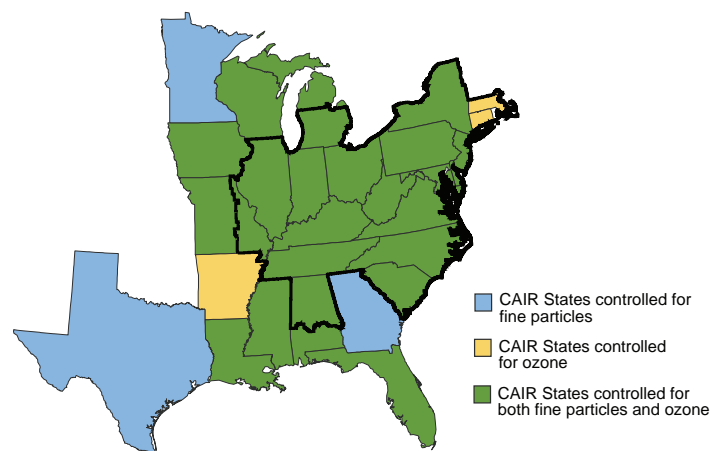
place CAIR that will help states address the interstate air emissions transport problem in a timely way and that fully comply with the requirements of the Clean Air Act and the opinions of the D.C. Circuit Court.

### Current CAIR Implementation in NBP States

All NBP states, except Rhode Island, are included in the CAIR NO<sub>x</sub> ozone season program (see Figure 10). Furthermore, the CAIR NO<sub>x</sub> ozone season program includes six additional eastern states (Florida, Iowa, Louisiana, Mississippi, Arkansas, and Wisconsin) and full state coverage in Alabama, Missouri and Michigan. The 2009 CAIR NO<sub>x</sub> ozone season cap is 580,000 tons.

NBP states affected by CAIR transitioned to the CAIR NO<sub>x</sub> ozone season program on May 1, 2009. In addition, most NBP states (except Rhode Island, Massachusetts, and Connecticut) are also subject to emission reductions under the CAIR annual NO<sub>x</sub> programs to help states attain the NAAQS for PM<sub>2.5</sub>. States meet their NO<sub>x</sub> SIP Call obligations using the CAIR NO<sub>x</sub> ozone season trading program and, as a result, CAIR allows states to include all of their NBP sources in the CAIR NO<sub>x</sub> ozone season program (even if they would

**Figure 10: Transition from the NBP to CAIR**



#### Notes:

- States in the NBP region are shown inside the black boundary line.
- EPA has proposed and is finalizing a rule to stay, or suspend, the effectiveness of CAIR in Minnesota.

Source: EPA, 2009

not otherwise be affected by CAIR). Most states used this flexibility, and those that did not are pursuing other strategies to meet their 2009 NO<sub>x</sub> SIP Call reduction requirements from their NBP sources. Rhode Island has decided not to join the CAIR trading program but must continue to meet its NO<sub>x</sub> SIP Call reduction requirements.

The 2009 CAIR NO<sub>x</sub> ozone season emission cap for EGUs is at least as stringent as the NBP, and in some states is tighter. The trading budget for any NBP state that includes its industrial units under CAIR will remain the same for those units as it was in the NBP. CAIR also allows sources to bank and use pre-2009 NBP allowances for CAIR NO<sub>x</sub> ozone season program compliance on a 1:1 basis, thereby

giving sources in those states the incentive to begin reducing their emissions sooner. Flow control no longer applies in 2009 and beyond, so transferred NBP allowances may be used under CAIR on a straight 1:1 basis with no restrictions or time limits.

Furthermore, sources outside of the NBP region can buy and use pre-2009 NBP allowances in the CAIR NO<sub>x</sub> ozone season trading program. Finally, in order to be in compliance, NBP sources that did not have enough allowances in their accounts at the end of the reconciliation period to cover their 2008 ozone season emissions surrendered 2009 CAIR allowances at a 3:1 ratio.





## Appendix A: Ozone Season NO<sub>x</sub> Emissions (Tons) from NBP Sources, 1990-2008, and 2008 State Trading Budgets

State	1990	2000	2003	2004	2005	2006	2007	2008	2008 Budget
AL	89,758	84,560	50,895	40,564	33,632	27,812	28,744	30,221	25,497
CT	11,203	4,697	2,070	2,191	3,022	2,514	2,152	1,721	4,477
DC	576	134	72	35	279	115	76	133	233
DE	13,180	5,256	5,414	5,068	6,538	4,763	5,454	4,285	5,227
IL	124,006	119,460	48,917	40,976	37,843	36,343	35,630	34,126	35,557
IN	218,333	145,722	100,772	68,375	57,249	55,510	56,374	57,838	55,729
KY	153,179	101,601	63,057	40,394	36,730	37,461	40,210	39,386	36,109
MA	40,367	14,324	9,265	7,481	8,269	5,464	3,666	3,230	12,861
MD	54,375	28,954	19,257	19,944	20,989	18,480	16,521	10,667	15,466
MI	120,132	80,425	45,614	39,848	42,157	40,353	34,354	34,358	31,247
MO	64,272	34,058	29,407	16,190	18,809	15,917	12,961	12,777	13,459
NC	92,059	73,082	51,943	39,821	32,888	30,387	28,390	27,105	34,703
NJ	44,359	14,630	11,003	10,807	11,277	8,692	7,773	7,139	13,022
NY	84,485	43,583	34,815	34,157	36,633	26,339	24,728	20,934	41,385
OH	240,768	159,578	133,043	67,304	54,335	52,817	57,862	54,644	49,842
PA	199,137	87,329	51,530	52,140	51,125	52,806	57,615	56,747	50,843
RI	1,099	288	209	177	253	181	187	161	936
SC	56,153	39,674	34,624	25,377	18,193	18,376	18,418	17,552	19,678
TN	115,348	69,641	55,376	31,399	25,718	23,930	23,261	21,711	31,480
VA	51,866	40,043	32,766	25,448	22,309	20,491	22,957	19,596	21,195
WV	149,176	109,198	69,171	41,333	30,401	28,852	28,967	27,089	29,507
All NBP States	1,923,831	1,256,237	849,220	609,029	548,649	507,603	506,300	481,420	528,453

### Notes:

- Emissions for Alabama, Michigan, and Missouri are for units in the portion of the state that became subject to the NBP in 2004 (Alabama and Michigan) and 2007 (Missouri).
- The 2008 state budget values include opt-in allowances, where applicable (New York, Ohio, and West Virginia).
- Emissions for prior years reflect emission resubmissions as of April 1, 2009, and may differ slightly from numbers that appear in previous progress reports.

Source: EPA, 2009





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