Clean Air Interstate Rule, Acid Rain Program and Former NO_x Budget Trading Program

2010 Progress Report
Emission, Compliance, and Market Analyses

The Clean Air Interstate Rule (CAIR) and the Acid Rain Program (ARP) are both cap and trade programs designed to reduce emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) from power plants. On July 6, 2011, EPA finalized the Cross-State Air Pollution Rule (CSAPR), which will replace CAIR starting in 2012.

The CSAPR will require 27 states in the eastern half of the U.S. to improve significantly air quality by reducing power plant emissions of SO_2 and NO_x that cross state lines and contribute to smog (ground-level ozone) and soot (fine particle pollution) in other states. The first phase of compliance begins January 1, 2012 for SO_2 and annual NO_x reductions and May 1, 2012 for ozone season NO_x reductions. Additional SO_2 reductions are required by sixteen Group 1 states in 2014 to eliminate their contribution to downwind air quality problems.

CAIR, which will be implemented through 2011, also addresses regional interstate transport of ozone and fine particle ($PM_{2.5}$) pollution. CAIR requires certain eastern states to limit annual emissions of NO_x and SO_2, which contribute to the formation of ozone and $PM_{2.5}$. It also requires certain states to limit ozone season NO_x emissions, which contribute to the formation of smog during the summer ozone season (May to September). CAIR includes three separate cap and trade programs to achieve the required reductions: the CAIR NO_x ozone season trading program, the CAIR NO_x annual trading program, and the CAIR SO_2 annual trading program. The CAIR NO_x ozone season and annual programs began in 2009, while the CAIR SO_2 annual program began in 2010. All three programs will be implemented through the 2011 compliance periods. The CSAPR will replace CAIR starting in 2012. The reduction in ozone and $PM_{2.5}$ formation resulting from implementation of CAIR provides health benefits as well as improved visibility in national parks and improvements in freshwater aquatic ecosystems in the eastern U.S.

The ARP, established under Title IV of the 1990 Clean Air Act (CAA) Amendments, requires major emission reductions of SO_2 and NO_x, the primary precursors of acid rain, from the power sector. 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 traditional, rate-based regulatory system. Since the program began in 1995, the ARP has achieved significant emission reductions.

The NO_x Budget Trading Program (NBP) operated from 2003 to 2008. The NBP was a cap and trade program that required NO_x emission reductions from power plants and industrial units in the eastern U.S. during the summer months.

For the first time, EPA is combining emissions and compliance data for both CAIR and the ARP into one report to more holistically show reductions in power sector emissions of SO_2 and NO_x and the collective effect of these regional programs on human health and the environment. Over the next several months, EPA will release a series of reports summarizing progress in 2010 under both CAIR and the ARP. This first report presents 2010 data on combined emission reductions and compliance results for CAIR and the ARP. This report also presents some historic NBP emissions data and evaluates shared progress under these programs in 2010 by analyzing emission reductions and market activity. A forthcoming report will compare changes in emissions to changes in a variety of human health and environmental indicators. For more information on the CSAPR, please visit the <www.epa.gov/crossstaterule/>. For more information on CAIR, please visit < www.epa.gov/airmarkets/progsregs/cair/>. For more information on the ARP,

please visit <www.epa.gov/airmarkets/progsregs/arp/>. For more information on the NBP, please visit <www.epa.gov/airmarkets/progsregs/nox/sip.html>.

Figure 1 contains important milestones for CAIR, ARP, CSAPR, and the former NBP.

CAIR Litigation and the Cross-State Air Pollution Rule

CAIR was finalized in 2005. However, in July 2008, the U.S. Court of Appeals for the D.C. Circuit granted several petitions for review of CAIR, finding significant flaws in the rule. Subsequently, in December 2008, the court issued a ruling to keep CAIR and the CAIR Federal Implementation Plans (FIPs) — including the CAIR trading programs — in place temporarily until EPA issues new rules to replace the CAIR and the CAIR FIPs.

On July 6, 2011, EPA finalized the Cross-State Air Pollution Rule (CSAPR) to replace CAIR. This rule responds to the court's concerns and fulfills the "good neighbor" provision of the Clean Air Act by addressing the problem of air pollution that is transported across state boundaries.

In a separate but related regulatory action, EPA also issued a supplemental notice of proposed rulemaking (SNPR) to require six states — Iowa, Kansas, Michigan, Missouri, Oklahoma, and Wisconsin — to make summertime NO_x reductions under the CSAPR ozone-season control program. Finalizing this supplemental proposal would bring the total number of covered states under the CSAPR to 28.

Visit <www.epa.gov/crossstaterule/> for more information.

CAIR, ARP, and NBP Affected States and Units

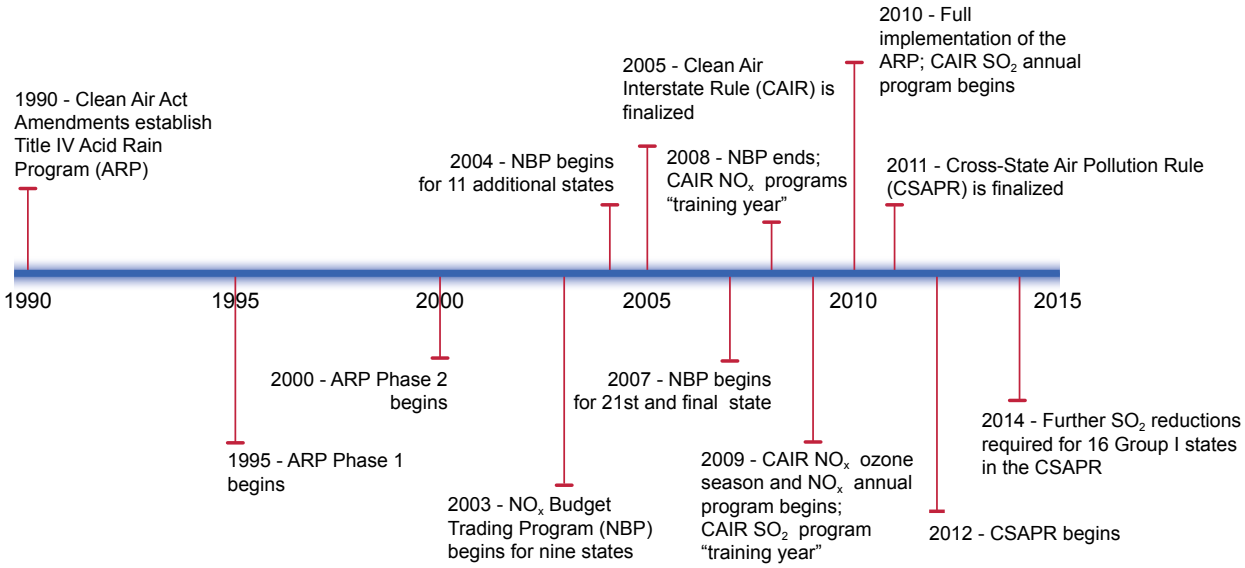
Affected States

The ARP is a nationwide program affecting large fossil fuel-fired power plants across the country. CAIR covers 27 eastern states and the District of Columbia (D.C.) and requires reductions in annual emissions of SO_2 and NO_x from 24 states and D.C. (to achieve improvements in fine particle pollution in downwind areas) and emission reductions of NO_x during the ozone season from 25 states and D.C. (to achieve improvements in ozone pollution in downwind areas). The former NBP affected 20 eastern states and D.C. State coverage for CAIR, ARP, and NBP is shown in Figure 2 on page 3.

Affected Units

The CAIR SO_2 and NO_x annual programs generally apply to large EGUs — boilers, turbines, and combined cycle units that primarily burn fossil fuels to generate electricity for sale. The CAIR NO_x ozone season program includes EGUs as well as, in some states, large industrial units that produce electricity or

Figure 1: History of CAIR, ARP, CSAPR, and Former NBP



Source: EPA, 2011

steam primarily for internal use and that have been carried over from the NBP. Examples of these units are boilers and turbines at heavy manufacturing facilities, such as paper mills, petroleum refineries, and iron and steel production facilities. These units also include steam plants at institutional settings, such as large universities or hospitals.

In 2010, there were 3,349 affected EGUs at 955 facilities in the CAIR SO_2 and NO_x annual programs and 3,309 EGUs and industrial facility units at 953 facilities in the CAIR NO_x ozone season program (see Table 1, on page 4). The variation in the number of units covered under the programs is due to the difference in states that are included in each program (see Figure 2, below). The CAIR programs cover a range of unit types, including units that operate year round to provide baseload power to the electric grid as well as units that provide power on peak demand days only and may not operate at all during some years.

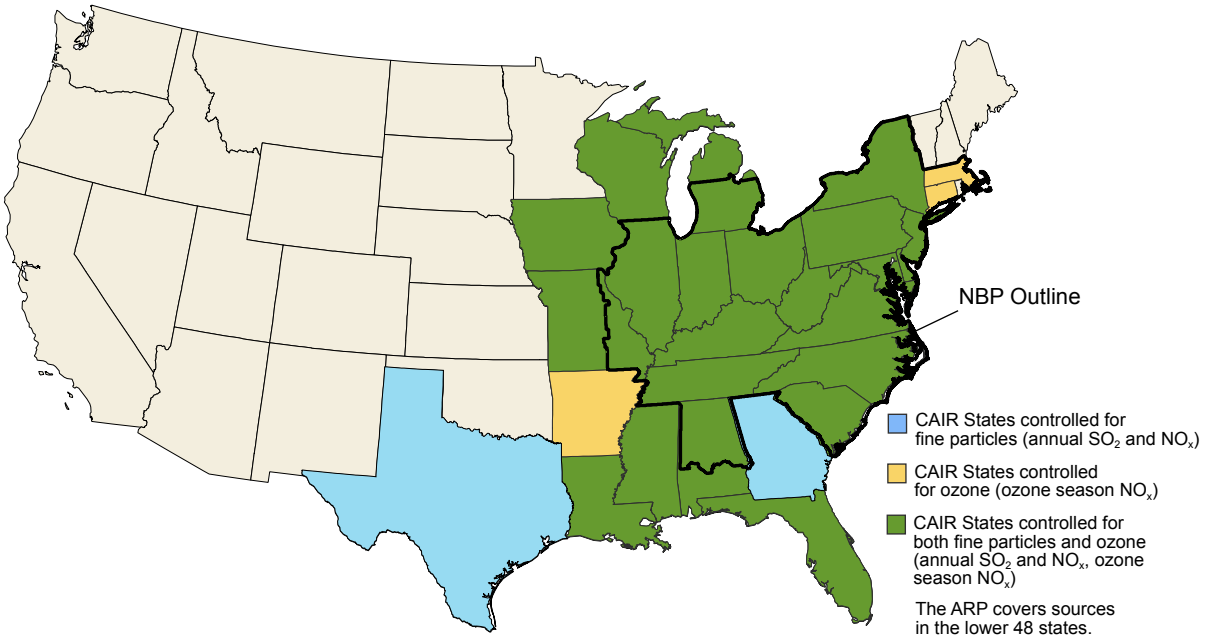
The SO_2 requirements under the ARP apply to the 3,613 large (greater than 25 megawatts) fossil fuel-fired combustion units that serve a generator that provides electricity for sale at 1,241 facilities across the country. The vast majority of ARP SO_2 emissions result from coal-fired EGUs, although the program also applies to oil and gas units. Of the 3,349 units in the CAIR SO_2 program, 2,626 (78 percent) were also covered by the ARP in 2010. The other units are largely fossil fuel generation units that entered SO_2 control under the broader applicability requirements of CAIR.

The ARP also requires NO_x emission reductions for older, large coal-fired EGUs by limiting their NO_x emission rate (expressed in lb/mmBtu). 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 two million tons less than the projected level for the year 2000 without implementation of Title IV. In 2010, 956 units at 379 facilities were subject to the ARP NO_x program.

Emission Reductions

Table 2, on page 5, shows a large reduction in annual SO_2 and NO_x emissions from CAIR and ARP sources between 2005 and 2010. Tons of SO_2 emitted fell 49 percent from the 2005 level, and annual NO_x emissions dropped 42 percent. During this same period, ozone season NO_x emissions from CAIR sources alone decreased by approximately 27 percent. These reductions occurred while electricity demand (measured as heat input) remained relatively stable, indicating that the reduction in emissions was not driven by decreased electric generation. Instead, there was a significant drop in emission rate for sources in all three programs: 49 percent for SO_2 sources, 42 percent

Figure 2: CAIR, ARP, and NBP States



Note: In November 2009, EPA finalized a rule staying the requirements of CAIR for Minnesota. Minnesota is therefore not currently included in the CAIR annual SO_2 and NO_x programs.
Source: EPA, 2011

Table 1: Affected Units in CAIR and ARP, 2010

Fuel	ARP SO_2 Program	ARP NO_x Program	CAIR NO_x Ozone Season Program	CAIR NO_x and SO_2 Annual Programs
Coal EGUs	1,055	944	875	922
Gas EGUs	2,333	10	1,657	1,945
Oil EGUs	200	0	555	463
Industrial Units	0	0	203	0
Unclassified EGUs	9	0	1	4
Other Fuel EGUs	16	2	18	15
Total Units	**3,613**	**956**	**3,309**	**3,349**

Notes:
- "Unclassified" units have not submitted a fuel type in their monitoring plan and did not report emissions.
- "Other" fuel refers to units that burn waste, wood, petroleum coke, tire-derived fuel, etc.

Source: EPA, 2011

for annual NO_x sources, and 25 percent for ozone season NO_x sources. A drop in emission rate represents an overall increase in the environmental efficiency of these sources as power generators installed controls, ran their NO_x controls year round, switched to different fuels, or otherwise cut their SO_2 and NO_x emissions while meeting relatively steady demand for power. Most of the reductions since 2005 are from early reduction incentives and stricter emission limits under CAIR.

Between 2009 and 2010, CAIR and ARP sources continued to reduce their SO_2 emissions and emission rate. These reductions occurred despite an 8 percent increase in demand for electricity. Annual NO_x emissions from CAIR and ARP sources, however, rose slightly (4 percent) and in line with a similar increase in heat input (6 percent) during this time. Finally, CAIR sources' ozone season NO_x emissions increased considerably (20 percent) as demand for electricity at these facilities rose substantially (more than 16 percent). Despite these increases in NO_x emissions as sources ran their controls less often, facilities were still below both the CAIR NO_x ozone season and CAIR NO_x annual budgets for the year.

Visit <www.epa.gov/airmarkets/quarterlytracking.html> for the most up-to-date emissions and control data for sources in the ARP.

Milestone Years for Measuring Progress under CAIR and ARP

1980: The Clean Air Act specified that annual SO_2 emissions be cut to 10 million tons below the 1980 level

1990: Baseline emission levels for the ARP

1995: First year of the ARP (Phase 1)

2000: Phase 2 of the ARP

2005: Baseline emission levels for CAIR

2008: "Training year" for CAIR NO_x monitoring. Units participating in the two CAIR NO_x trading programs were required to monitor and report their emissions, but were not required to hold allowances for compliance

2009: First year of CAIR NO_x annual and CAIR NO_x ozone season programs (Phase 1). "Training year" for CAIR SO_2 monitoring

2010: First year of CAIR SO_2 annual program (Phase 1)

Table 2: Comparison of Emissions, Emission Rates, and Heat Input for CAIR, ARP, and NBP Sources, 2000–2010

CAIR and ARP Annual SO_2 Trends

	SO_2 Emissions (thousand tons)					SO_2 Rate (lb/mmBtu)					Heat Input (billion mmBtu)				
Fuel	2000	2005	2008	2009	2010	2000	2005	2008	2009	2010	2000	2005	2008	2009	2010
Coal	10,707	9,835	7,514	5,653	5,089	1.04	0.95	0.74	0.63	0.53	20.67	20.77	20.25	18.02	19.29
Gas	28	36	10	6	7	0.02	0.01	0.00	0.00	0.00	3.71	5.35	6.22	6.50	7.19
Oil	464	347	83	54	44	0.76	0.71	0.35	0.29	0.21	1.22	0.98	0.47	0.37	0.41
Other	1	4	9	8	26	0.23	0.27	0.28	0.27	0.53	0.01	0.03	0.06	0.06	0.10
Total	**11,201**	**10,223**	**7,616**	**5,722**	**5,166**	**0.88**	**0.75**	**0.56**	**0.46**	**0.38**	**25.61**	**27.13**	**27.00**	**24.95**	**26.99**

CAIR and ARP Annual NO_x Trends

	NO_x Emissions (thousand tons)					NO_x Rate (lb/mmBtu)					Heat Input (billion mmBtu)				
Fuel	2000	2005	2008	2009	2010	2000	2005	2008	2009	2010	2000	2005	2008	2009	2010
Coal	4,586	3,356	2,816	1,847	1,922	0.44	0.32	0.28	0.20	0.20	20.67	20.77	20.25	18.27	19.29
Gas	321	142	130	133	139	0.17	0.05	0.04	0.04	0.04	3.71	5.35	6.22	6.71	7.19
Oil	195	129	46	34	34	0.32	0.26	0.19	0.18	0.17	1.22	0.98	0.47	0.38	0.41
Other	2	6	5	5	7	0.26	0.42	0.16	0.12	0.13	0.01	0.03	0.06	0.09	0.10
Total	**5,104**	**3,633**	**2,996**	**2,020**	**2,102**	**0.40**	**0.27**	**0.22**	**0.16**	**0.16**	**25.61**	**27.13**	**27.00**	**25.45**	**26.99**

NBP Ozone Season NO_x Trends

	NO_x Emissions (thousand tons)			NO_x Rate (lb/mmBtu)			Heat Input (billion mmBtu)		
Fuel	2000	2005	2008	2000	2005	2008	2000	2005	2008
Coal	1,111	494	456	0.46	0.19	0.19	4.85	5.10	4.93
Gas	15	23	17	0.08	0.05	0.04	0.37	0.85	0.85
Oil	34	32	9	0.21	0.21	0.14	0.32	0.31	0.13
Other	0	0	0	0.74	0.50	0.13	0.00	0.00	0.01
Total	**1,160**	**549**	**482**	**0.42**	**0.18**	**0.16**	**5.54**	**6.27**	**5.91**

CAIR Ozone Season NO_x Trends

	NO_x Emissions (thousand tons)					NO_x Rate (lb/mmBtu)					Heat Input (billion mmBtu)				
Fuel	2000	2005	2008	2009	2010	2000	2005	2008	2009	2010	2000	2005	2008	2009	2010
Coal	1,398	695	625	442	527	0.45	0.22	0.20	0.17	0.18	6.19	6.31	6.14	5.21	5.85
Gas	62	43	34	33	42	0.15	0.06	0.05	0.04	0.04	0.84	1.47	1.40	1.53	1.96
Oil	83	72	28	19	22	0.29	0.27	0.20	0.18	0.16	0.57	0.53	0.28	0.21	0.27
Other	1	2	2	2	2	0.15	0.17	0.14	0.14	0.12	0.02	0.02	0.03	0.02	0.04
Total	**1,545**	**812**	**689**	**495**	**594**	**0.41**	**0.20**	**0.18**	**0.14**	**0.15**	**7.62**	**8.33**	**7.85**	**6.97**	**8.12**

See Page 6 for Notes on Table 2

Notes from Table 2:

- The data shown here for the annual programs and the NBP reflect totals for those facilities required to comply with each program in each respective year. This means that CAIR NO_x annual program facilities are not included in the annual NO_x data for 2005 or 2008, and CAIR SO_2 annual program facilities are not included in the annual SO_2 data for 2005, 2008, or 2009.
- The CAIR NO_x ozone season table includes emissions and heat input data for 2005 that were reported under other programs. For facilities that were not covered by another program and did not report 2005 emissions, their reported emissions for 2008 were substituted.
- 2008 was a "training year" for facilities covered by the CAIR NO_x annual and ozone season programs.
- 2009 was a monitoring and reporting "training year" for facilities covered by the CAIR SO_2 annual program.
- Fuel type represents primary fuel type; units might combust more than one fuel.
- Totals may not reflect the sum of individual rows due to rounding.
- Each year's total emission rate does not equal the arithmetic mean of the four fuel-specific rates, as each facility influences the annual emission rate in proportion to its heat input, and heat input is unevenly distributed across the fuel categories.
- EPA data in these tables and used elsewhere in this report are current as of July 2011, and may differ from past or future reports as a result of resubmissions by sources and ongoing data quality assurance activities.

Source: EPA, 2011

SO_2 Emission Reductions

Figure 3 shows that the CAIR SO_2 program continues and complements the ARP's history of SO_2 emission reductions. In 2010, the first year of operation of the CAIR SO_2 trading program, sources in both the CAIR SO_2 annual program and the ARP together reduced SO_2 emissions by over 10 million tons (67 percent) from 1990 levels (before implementation of the ARP), 6 million tons (54 percent) from 2000 levels (ARP Phase 2), and 5 million tons (49 percent) from 2005 levels (before implementation of CAIR). All ARP and CAIR sources together emitted a total of 5.2 million tons of SO_2 in 2010, well below the ARP's statutory annual cap of 8.95 million tons.

Annual SO_2 emissions from sources in the CAIR SO_2 program alone fell from 9 million tons in 2005 to 4.4 million tons in 2010, a 51 percent reduction. Between 2009 and 2010, SO_2 emissions fell 123,000 tons, or 6 percent. However, the 2010 emissions total is higher than the CAIR SO_2 program's state budget total of 3.6 million tons, indicating that affected sources used banked allowances carried over from the ARP for compliance with CAIR (see Table 3 on page 11).

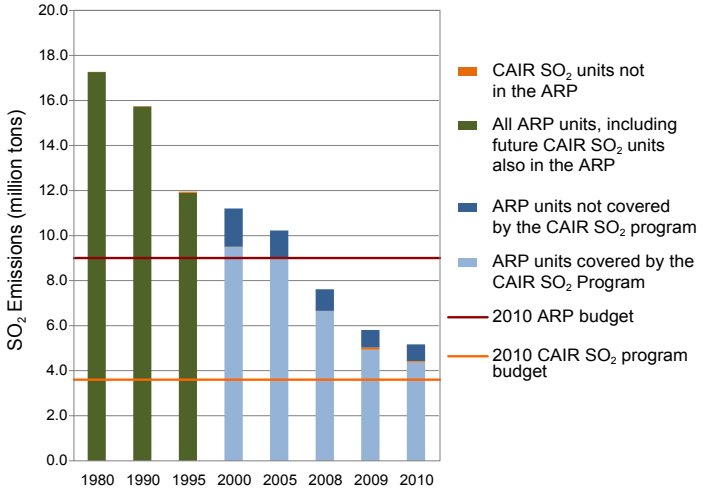
ARP units alone emitted 5.1 million tons of SO_2 in 2010, meaning that ARP sources reduced emissions by 10.6 million tons (67 percent) from 1990 levels and 12.1 milllion tons (70 percent) from 1980 levels.

The states with the highest emitting sources in 1990 have generally seen the greatest SO_2 reductions under the ARP, and this trend continues under CAIR (see Figure 4 on page 7). Most of these states are upwind of the areas the ARP and CAIR were designed to protect, and reductions have resulted in important environmental and health benefits over a large region.

From 1990 to 2010, annual SO_2 emissions in the nationwide ARP dropped in 40 states and D.C. by a total of approximately 10.5 million tons. In contrast, annual SO_2 emissions increased by a total of only 30,700 tons in eight states (Idaho, Louisiana, Montana, North Dakota, Nebraska, Oregon, Rhode Island, and Vermont) from 1990 to 2010.

Between 2005 and 2010, annual SO_2 emissions fell in all 27 states in the CAIR region with the exception of Arkansas and D.C., which increased emissions by a total of only 933 tons. Sixteen states and D.C. exceeded their state SO_2 emission budgets. Thirty-five ARP units installed SO_2 controls in 2010, reducing their collective SO_2 emission rate from 1.15 lb/mmBtu

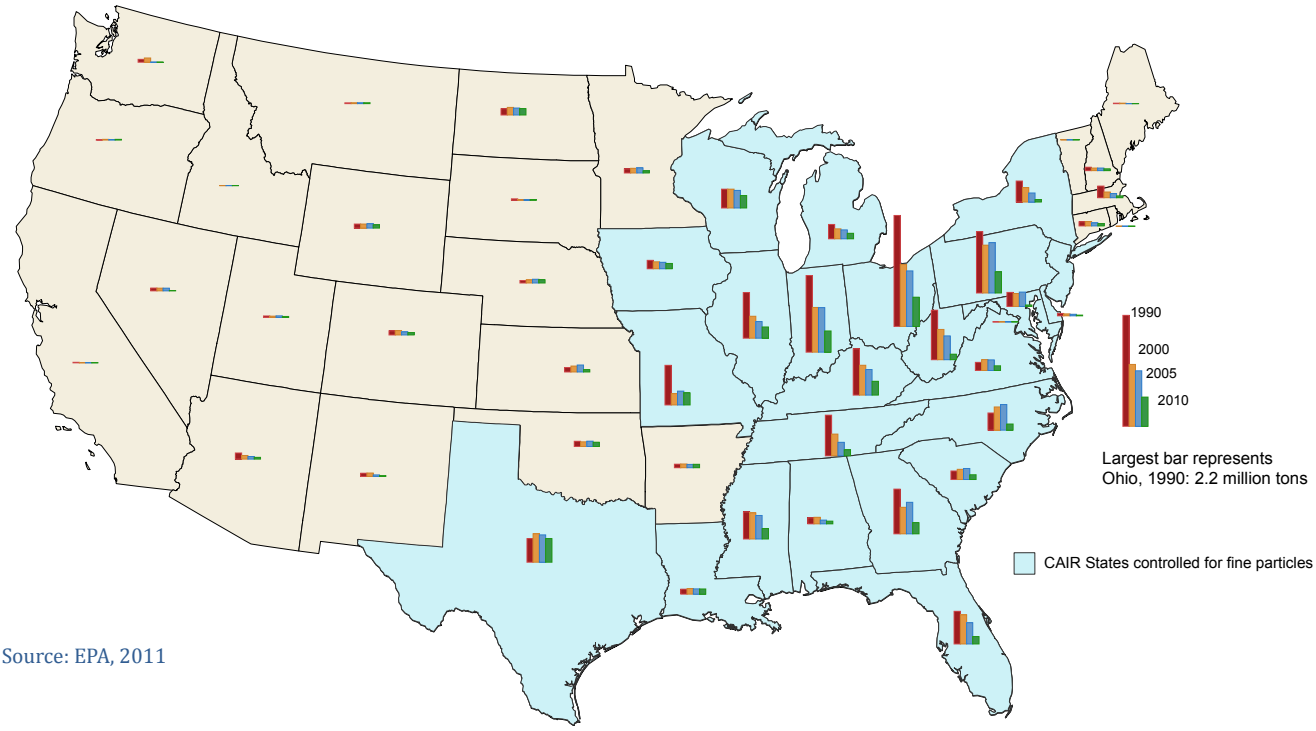
Figure 3: SO_2 Emissions from CAIR SO_2 Annual Program and ARP Sources, 1980–2010



Note: For CAIR units not in the ARP, the 2009 annual SO_2 emissions were applied retroactively for each pre-CAIR year following the year in which the unit began operating.

Source: EPA, 2011

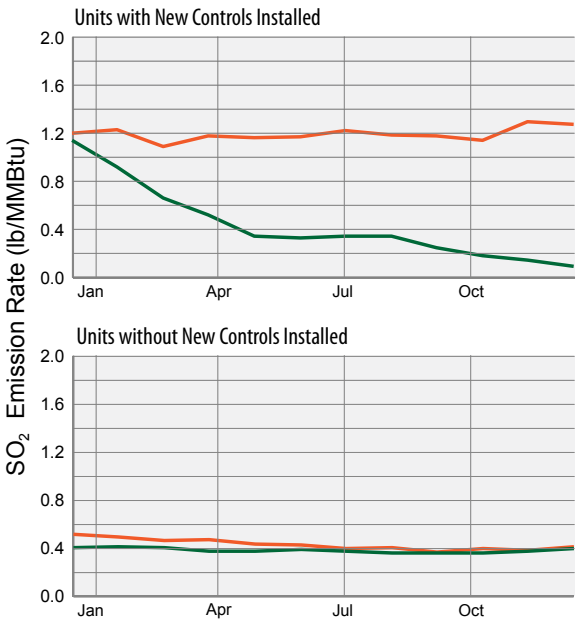
Figure 4: State-by-State Annual SO_2 Emission Levels for CAIR and ARP Sources, 1990–2010



Source: EPA, 2011

in January to 0.10 lb/mmBtu in December. The remaining sources in the ARP reported a steady annual SO_2 rate of about 0.41 lb/mmBtu (see Figure 5). Had these newly-controlled units maintained their collective annual 2009 emission rate of 1.20 lb/mmBtu through 2010, their estimated emissions would have remained around a half million tons. In actuality, the 35 units emitted 64 percent less SO_2 in 2010 than in 2009 by adding scrubbers, contributing about half of the total program-wide reduction of 600,000 tons between 2009 and 2010. Because the new controls were installed at different times throughout 2010, the annual reduction reflects only partial operation, and the overall benefits of the new systems will be even greater in 2011.

Figure 5: Monthly SO_2 Emission Rates, 2010



Source: EPA, 2011

NO_x Emission Reductions

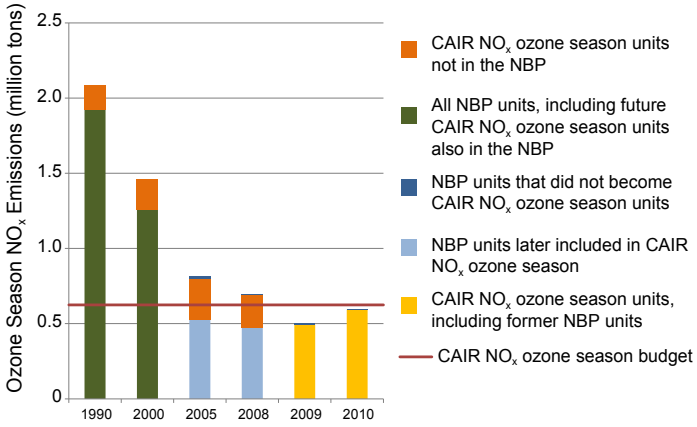
Ozone Season NO_x Reductions

Figure 6, below, shows ozone season NO_x emissions from 1990 to the present for CAIR and NBP sources. In 2010, the second year of the CAIR NO_x ozone season program, sources from both CAIR and the former NBP, together with a small number of sources that were previously in the NBP but did not enter CAIR, reduced their overall NO_x emissions from 816,000 tons in 2005 (before implementation of CAIR) to 599,000 tons in 2010, a decrease of 27 percent. NO_x emissions were nearly 1.5 million tons lower (71 percent) than in 1990 and 860,000 tons lower (59 percent) than in 2000 (before implementation of the NBP).

Between 2005 and 2010, ozone season NO_x emissions from sources in the CAIR program alone have fallen 218,000 tons, a decrease of 27 percent. From 2009 to 2010, however, ozone season NO_x emissions from sources in the CAIR NO_x ozone season program increased by 99,000 tons (20 percent) as sources operated controls less often and electricity demand rose. Despite the year-over-year increase, ozone season NO_x emissions totaled 594,000 tons in 2010, 5 percent below the 2010 regional emission budget of 624,698 tons.

The average NO_x emission rate is a key measure of program effectiveness. While emissions may vary year to year due to changes in electricity demand the average ozone season NO_x emission rate has fallen every year since 2004 — except 2010. The driver of the increase in rate was coal-fired units with add-on controls. The NO_x emission rate at these units, which are historically responsible for the deepest reductions, increased as a group over 14 percent from 2009 to 2010.

Figure 6: Ozone Season NO_x Emissions from CAIR and NBP Sources, 1990–2010



Note: For CAIR units not in the NBP, the 2008 NO_x emissions were applied retroactively to 1990 and 2000 if the unit operated in the previous year's ozone season.
Source: EPA, 2011

Ozone season NO_x mass emissions rose about 99,000 tons between 2009 and 2010. Nearly a third of the increase (28,192 tons) resulted from fifty coal-fired units with add-on controls that posted significantly poorer performance in 2010. These fifty units "dialed back" control removal efficiency or even turned installed controls off. At 24 units, the 2010 NO_x emission rate was double that of 2009. In an emissions trading program, operators of plants are assumed to optimize operations by balancing the costs of fuel, allowances, and running controls. For example, the relatively low cost of gas drove the 35 percent increase in gas-fired generation in 2010. Similarly, the drop in allowance prices could lead to a higher NO_x emission rate. EPA expects the average NO_x emission rate to continue to improve in future years under the regulatory certainty provided by CSAPR. The higher NO_x allowance prices that should exist in 2012 under CSAPR would provide incentive for sources to improve the effectiveness of existing pollution controls.

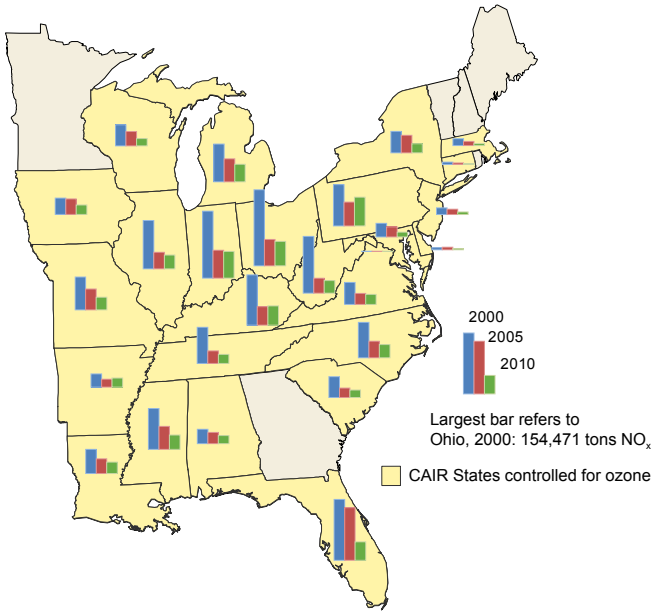
Between 2005 and 2010, ozone season NO_x emissions from CAIR and former NBP sources fell in every state participating in the CAIR NO_x ozone season program except Pennsylvania, Arkansas, Kentucky, and D.C. (see Figure 7, below), where emissions increased by a total of 15,000 tons. In the 2010 ozone season, the total emissions from participating sources were about 31,000 tons below the regional emission budget. Sixteen states had emissions below their allowance budgets, collectively by about 80,000 tons. Another ten states exceeded their 2010 budgets by a total of about 49,000 tons, indicating that, on an aggregate basis, sources within those states covered a portion of their emissions with allowances banked from earlier years, transferred from an out-of-state account, or purchased from the market.

In addition to the CAIR NO_x ozone season program and the former NBP, prior programs such as the Ozone Transport Commission's (OTC) NO_x Budget Program and current regional and state NO_x emission control programs have also contributed significantly to the ozone season NO_x reductions achieved by sources in 2010.

High Electric Demand Days

Ozone season demand for electricity is driven by economic conditions and weather. Figure 8, on page 9, compares 2009

Figure 7: State-by-State Ozone Season NO_x Emission Levels from CAIR Sources, 2000–2010



Note: The 2000 and 2005 ozone season values reflect data that were reported under other programs (ARP and NBP). For facilities that were not covered by another program and did not report 2000 or 2005 emissions, their reported emissions for the earliest subsequent year (usually the 2008 training year) were substituted.

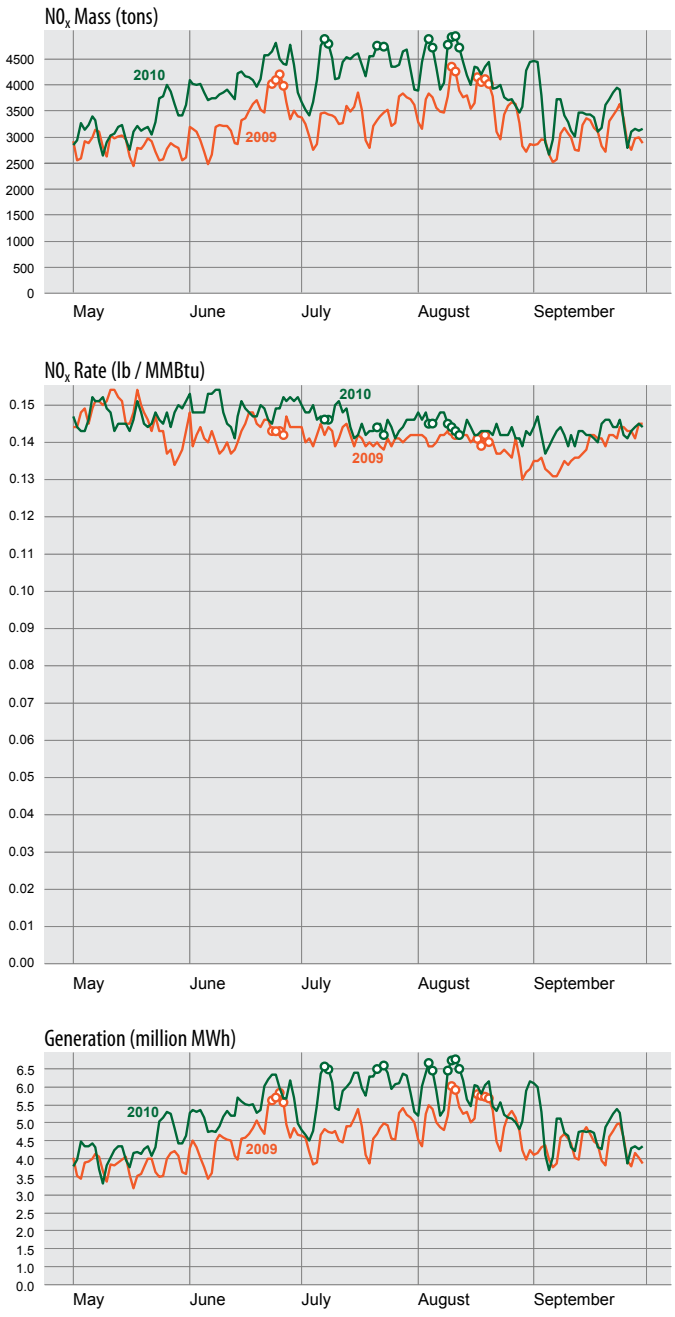
Source: EPA, 2011

and 2010 ozone season daily NO_x emissions and generation (as measured by gross megawatt hours), and highlights the ten days of each year's peak generation. Comparing the ten peak generation days in 2009 to 2010, generation increased 14 percent, NO_x emissions grew proportionately (17 percent), while the NO_x emission rate increased by less than two percent. The fact that the NO_x rate during the ten days of highest electric demand remained below the ozone season average implies that the increased demand did not result in less efficient, higher-emitting units being called into service, as had historically been the case.

Annual NO_x Reductions

Figure 9, on page 10, shows that from 1990 to 2010, annual NO_x emissions from CAIR and ARP units together dropped by about 4.3 million tons to 2.1 million tons, a decrease of 67 percent. In 2010, the second year of the CAIR NO_x annual program, NO_x emissions from all ARP and CAIR units were 1.5 million tons lower (42 percent) than in 2005 and 3 million tons lower (59 percent) than in 2000.

Figure 8: Ozone Season Daily NO_x Emissions and Generation



Source: EPA, 2011

Emissions from CAIR NO_x annual program sources alone were 1.43 million tons in 2010, 73,000 tons (5 percent) below the 2010 CAIR NO_x annual program's regional budget of 1.5 million tons. Annual NO_x emissions were 1.2 million tons lower (47 percent) than in 2005, but were 115,000 tons (9 percent) higher than in 2009. This recent increase was largely a result of sources not operating NO_x controls as often and increased demand for electricity.

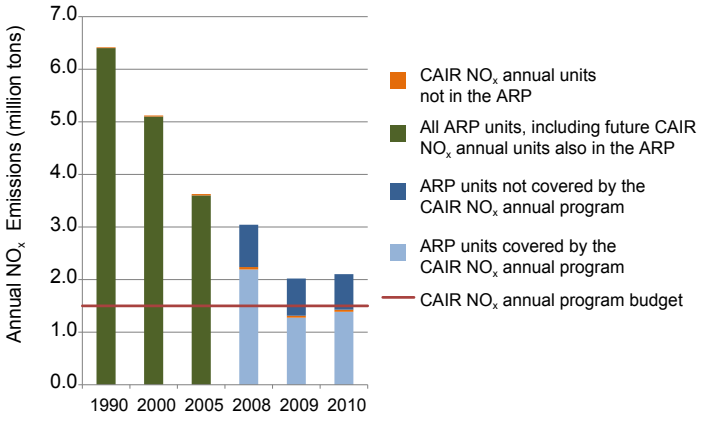
ARP sources emitted 2.1 million tons of NO_x in 2010. This level is 6 million tons less than the projected level in 2000 without the ARP, and triple the Title IV NO_x emission reduction objective.

Although the ARP and CAIR NO_x programs were responsible for a large portion of these annual NO_x reductions, other programs — such as the NBP, the OTC NO_x Budget Program, and other regional and state NO_x emission control programs — also contributed significantly to the annual NO_x reductions achieved by sources in 2010.

Figure 10, below, shows that, compared with 2005, before implementation of CAIR, sources in the CAIR NO_x annual program continued to reduce year-round emissions in 2010 as program participants operated NO_x control devices on EGUs outside the summer months. From 2005 to 2010, NO_x emissions from units in the CAIR NO_x annual program and ARP fell 42 percent, while heat input remained stable, falling less than one percent.

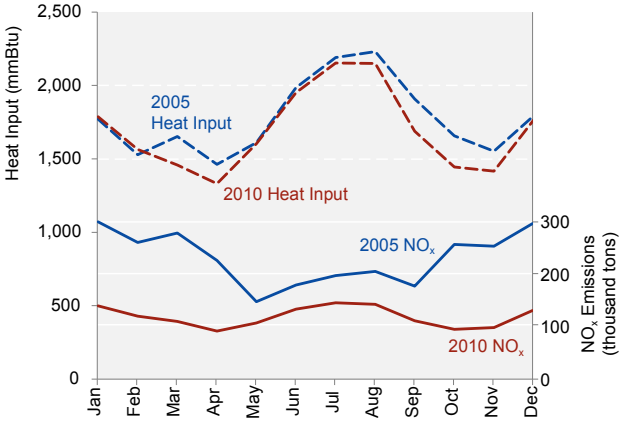
From 1990 to 2010, all states participating in the CAIR NO_x annual program decreased their emissions, as indicated in Figure 11, on page 11. Comparing 2005 to 2010, all states in the CAIR region emitted less NO_x except Delaware and D.C., which increased their NO_x emissions by 855 tons. The total NO_x emissions from participating sources in 2010 were about 55,000 tons below the regional emission budget of 1,490,264 tons. Ten states and D.C. exceeded their 2010 budgets by a total of about 109,000 tons, indicating that, on an aggregate basis, sources within those states covered a portion of their emissions with allowances banked from earlier years, transferred from an out-of-state account, or purchased from the market.

Figure 9: Annual NO_x Emissions from CAIR and ARP Sources, 1990–2010



Note: For CAIR units not in the ARP in 1990, 2000, and 2005, the 2008 annual NO_x emissions were applied retroactively for each pre-CAIR year following the year in which the unit began operating.
Source: EPA, 2011

Figure 10: Monthly Emissions and Heat Input from CAIR NO_x Annual Program Sources, 2005 vs. 2010



Note: The CAIR NO_x annual program had not begun in 2005, so the set of participating units from 2008 was used as the 2005 baseline in this figure. Facilities that were not covered by the ARP did not report emissions in 2005. For these facilities, the earliest subsequent reported values, usually from the 2008 CAIR training year, were substituted.
Source: EPA, 2011

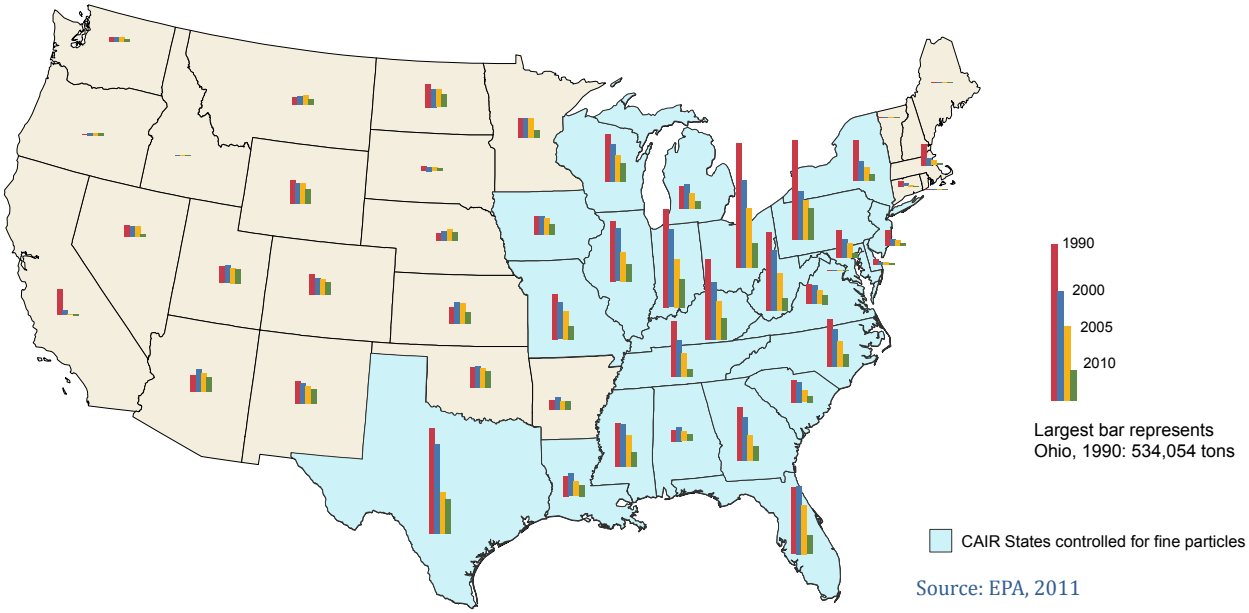
CAIR and ARP Program Compliance

SO_2 Programs

Because SO_2 allowances from the ARP are used by sources to comply with the CAIR SO_2 annual program, compliance results for both programs are displayed together in this report. Table 3, on page 11, shows how ARP and CAIR allowances were used. All ARP and CAIR SO_2 facilities were in compliance with both programs and held enough allowances to cover their SO_2 emissions.

2010 was the first year for compliance with the CAIR SO_2 program. Under this program, allowances are used to cover emissions based on the vintage year of the allowances, with pre–2010 vintage allowances used at 1 allowance for 1 ton of SO_2 emissions, and 2010 vintage allow-

Figure 11: State-by-State Annual NO_x Emission Levels for CAIR and ARP Sources, 1990–2010



Source: EPA, 2011

ances used at 2 allowances for 1 ton. For facilities covered by both CAIR and the ARP, reconciliation is a two-step process. First, ARP deductions are made. Then, any additional deductions to comply with the CAIR SO_2 program are made. The additional deductions under CAIR could be to cover the 2 for 1 use of 2010 allowances or to cover emissions for units that are subject to CAIR, but not the ARP.

Table 3: CAIR and ARP SO_2 Allowance Reconciliation Summary, 2010

Total Allowances Held (1995–2010 Vintage)	21,505,185
Affected Facility Accounts	14,599,394
Other (General and Non-Affected Facility Accounts):	6,905,791
Allowances Deducted for Acid Rain Compliance *	5,081,366
Penalty Allowance Deductions (2011 Vintage)	0
Banked Allowances (prior to CAIR SO_2 deductions)	16,423,819
Affected Facility Accounts:	9,518,028
Other (General and Non-Affected Facility Accounts):	6,905,791
Acid Rain Program Allowances Deducted for CAIR SO_2 Compliance	1,188,678
Banked Allowances	15,235,141
Affected Facility Accounts:	8,329,350
Other (General and Non-Affected Facility Accounts):	6,905,791

* Includes 6,111 allowances deducted from opt-ins for reduced utilization.
Source: EPA, 2011

Compliance Results

As of July 2, 2011, the reported 2010 SO_2 emissions by CAIR and ARP sources totaled 5,166,487 tons. Because of variation in rounding conventions, changes due to resubmissions by sources, and allowance compliance issues at certain units, this number is lower than the sums of emissions used for reconciliation purposes shown in Table 3, above. Therefore, the allowance totals deducted for actual emissions in Table 3 differ from the number of emissions shown elsewhere in this report.

CAIR and ARP SO_2 Programs

Reported emissions (tons):	**5,166,487**
Compliance issues, rounding, and report resubmission adjustments (tons):	**–45,912**
Emissions not covered by allowances (tons):	**0**
Additional vintage 2010 allowances deducted for CAIR:	**+1,143,358**
Total allowances deducted for emissions (includes some 2 for 1 CAIR deductions:	**6,263,933**

In 2010, almost 22 million SO_2 allowances were available for compliance under both programs (9 million vintage 2010 and almost 13 million banked from prior years). Just over 5 million allowances were deducted for ARP compliance and an additional 1.2 million allowances were deducted to complete reconciliation for CAIR. After reconciliation for both programs, over 15.2 million ARP SO_2 allowances were banked and carried forward to the 2011 compliance year.

NO_x Programs

CAIR NO_x Compliance Results

Tables 4 and 5 show how NO_x allowances were used in 2010. All covered facilities were in compliance with the CAIR NO_x annual and ozone season programs and held enough allowances to cover their NO_x emissions.

Table 4: CAIR NO_X Ozone Season Allowance Reconciliation Summary, 2010

Total Allowances Held (2003–2010 Vintage)	1,002,016
Affected Facility Accounts	14,599,394
Other (General, State Holding and Non-Affected Facility Accounts):	873,775
Allowances Deducted for CAIR NO_x Ozone Season Trading Program	587127
Penalty Allowance Deductions (2011 Vintage)	0
Banked Allowances	414,889
Affected Facility Accounts:	286,648
Other (General and Non-Affected Facility Accounts):	128,241

Source: EPA, 2011

Table 5: CAIR NO_x Annual Allowance Reconciliation Summary, 2010

Total Allowances Held (2009–2010 Vintage)	1,823,717
Affected Facility Accounts	1,723,440
Other (General, State Holding and Non-Affected Facility Accounts):	100,277
Allowances Deducted for CAIR NO_x Annual Trading Program	1,420,621
Penalty Allowance Deductions (2011 Vintage)	0
Banked Allowances	403,096
Affected Facility Accounts:	302,819
Other (General and Non-Affected Facility Accounts):	100,277

Source: EPA, 2011

On May 1, 2009, the NBP transitioned to the CAIR NO_x ozone season program and transferred a total of 275,367 allowances from the NBP to the CAIR NO_x ozone season program. By the end of the 2009 ozone season, 392,799 allowances were banked and available for program compliance in 2010. Because NO_x emissions in the 2010 ozone season were below the CAIR budget, sources were able to bank additional allowances, leaving 414,889 allowances available for use in 2011.

Under the CAIR NO_x annual program, 342,975 allowances were carried over from 2009. Because annual NO_x emissions in 2010 were also below the CAIR budget, after reconciliation, 403,096 allowances remained in the bank to be carried over into 2011.

ARP NO_x Compliance Results

The ARP NO_x Program does not impose a cap on NO_x 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 affected sources with the flexibility to meet the NO_x emission reduction requirements in a cost-effective manner. In 2010, all 956 units that were subject to the ARP NO_x Program achieved compliance.

Controls and Monitoring

To meet the ARP and CAIR emission reduction targets, some sources opt to install control technologies. A wide set of controls are available to help reduce emissions. The following is an analysis of controls on ARP and CAIR program coal-fired units and CAIR NO_x program combined cycle units in 2010.

SO_2 Controls in 2010

The wide variety of SO_2 control options available to sources includes switching to low sulfur coal or employing various types of flue gas desulfurization units (FGDs), such as fluidized bed limestone units. FGDs on coal-fired generators are the principal means of controlling SO_2. As discussed in detail above, 35 units in the ARP added new SO_2 controls in 2010. Sources added FGDs at 34 of the units in the CAIR SO_2 annual program. Across both programs the share of generation, measured in megawatt hours (MWh), at controlled units was 60 percent of coal-fired generation in 2010 (see Table 6 on page 13).

Compliance Results

As of July 3, 2011, the reported 2010 ozone season NO_x emissions by CAIR sources totaled 593,669 tons, and annual emissions totaled 1,427,301 tons. Because of variation in rounding conventions, changes due to resubmissions by sources, and allowance compliance issues at certain units, these numbers are different from the sums of emissions used for reconciliation purposes shown in Table 4 (ozone season reconciliation) and Table 5 (annual reconciliation). Therefore, the allowance totals deducted for actual emissions in Tables 4 and 5 differ from the number of emissions shown elsewhere in this report.

CAIR NO_X Ozone Season

Reported emissions (tons):	593,669
Compliance issues, rounding, and report resubmission adjustments (tons):	–45,912
Emissions not covered by allowances (tons):	0
Total allowances deducted for emissions:	587,127

CAIR NO_X Annual Program

Reported emissions (tons):	5,166,487
Compliance issues, rounding, and report resubmission adjustments (tons):	-6,680
Emissions not covered by allowances (tons):	0
Total allowances deducted for emissions	1,420,621

Table 6: SO_2 Controls in 2010 on Coal-Fired Units in the ARP and CAIR Annual SO_2 Program

SO_2 Control Type	Number of Units	Share of Units	Share of MWh Generation
FGD	427	38%	59%
Other	44	4%	1%
Uncontrolled	643	58%	39%

Note: Due to rounding, percentages shown may not add up to 100%.
Source: EPA, 2011

NO_x Controls in 2010

Sources have a variety of options by which to reduce NO_x emissions. New selective catalytic reduction units (SCRs), the most efficient NO_x controls, were installed at five generation units under the CAIR NO_x ozone season program in 2010. Units with add-on controls — SCR or selective non-catalytic reduction (SNCR) — accounted for nearly two-thirds of coal-fired generation (59 percent) and 80 percent of generation at combined cycle units (gas- or oil-fired). Although 124 coal-fired units and 15 combined cycle units remain uncontrolled, they represent only two percent of coal-fired generation and one percent of combined cycle generation under the CAIR NO_x ozone season program (see Table 7).

Table 7: NO_x Controls in 2010 CAIR NO_x Ozone Season Program

NO_x Control Type	Number of Coal-Fired Units	Share of Coal-Fired	Number of Combined Cycle Units (Gas- or Oil-Fired)	Share of MWh Generation
Combustion	446	37%	66	13%
Non-Controlled	124	2%	15	1%
Other Control	38	1%	91	6%
SCR	207	51%	317	80%
SNCR	127	8%	0	0%

Note: Due to rounding, percentages shown may not add up to 100%.
Source: EPA, 2011

Seven sources in the CAIR NO_x annual program installed add-on controls in 2010. The 347 coal-fired units with add-on controls (either SCRs or SNCRs) generated 57 percent of annual generation, and the 379 combined cycle units with SCRs generated 75 percent of annual generation (see Table 8 on page 14). Similar to the CAIR NO_x ozone season program, uncontrolled units represent two percent of coal-fired generation and one percent of combined cycle generation under the CAIR NO_x annual program.

Table 8: NO_x Controls in 2010 CAIR NO_x Annual Program

NO_x Control Type	Number of Coal-Fired Units	Share of Coal-Fired	Number of Combined Cycle Units (Gas- or Oil-Fired)	Share of MWh Generation
Combustion	436	38%	120	20%
Non-Controlled	99	2%	19	1%
Other Control	40	2%	88	4%
SCR	222	49%	379	75%
SNCR	125	8%	0	0%

Note: Due to rounding, percentages shown may not add up to 100%.
Source: EPA, 2011

Continuous Emission Monitoring Systems

Accurate and consistent emissions monitoring is the foundation of a cap and trade system. EPA has developed detailed procedures (40 CFR Part 75) to ensure that sources monitor and report emissions with a high degree of precision, accuracy, reliability, and consistency. Sources use continuous emission monitoring systems (CEMS) or other approved methods. Part 75 requires sources to conduct stringent quality assurance tests of their monitoring systems, such as daily and quarterly calibration tests and a semiannual or annual relative accuracy test audit. These tests ensure that sources report accurate data and provide assurance to market participants that a ton of emissions measured at one facility is equivalent to a ton measured at a different facility.

While many CAIR units with low levels of emissions did not have to use CEMS, the vast majority of NO_x emissions — over 99 percent — were measured by CEMS. Similarly, CEMS monitored over 99 percent of SO_2 emissions including 100 percent from coal-fired units and 18 percent from oil-fired units. Coal-fired units were required to use CEMS for NO_x concentration and stack gas flow rate to calculate and record their NO_x mass emissions. Oil-fired and gas-fired units could use a NO_x CEMS in conjunction with a fuel flow meter to determine NO_x mass emissions. Alternatively, for oil-fired and gas-fired units that either operated infrequently or had very low NO_x emissions, Part 75 provided low-cost alternatives to conservatively estimate NO_x mass emissions. The relatively low percentage for oil-fired units with CEMS is consistent with the decline in oil-fired heat input, as most of these units were used infrequently and qualified for reduced monitoring.

Market Activity

SO_2 Allowance Market in 2010

Over the first decade of the ARP, 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 budget and the new compliance deadlines. With the start of the CAIR SO_2 program in 2010, the Acid Rain SO_2 market essentially has become the CAIR SO_2 market. See Table 9, for a summary of the 2010 SO_2 allowance market.

Table 9: SO_2 Allowance Market in Brief (close of 2010)

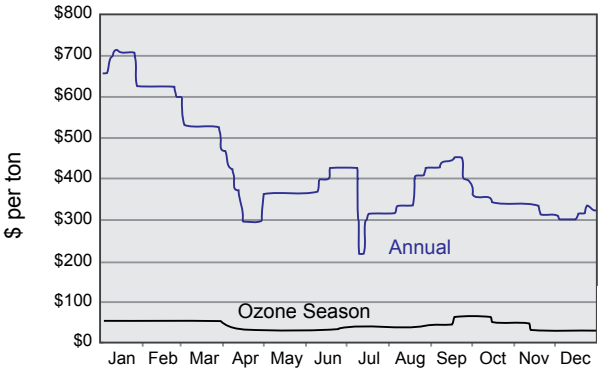
Total Value of the SO_2 Allowance Market:	$290 million
Average Nominal Price:	$19 per ton
Total Allowance Volume (Allowable Emissions):	15,233,537

Note: Total value of allowance market is a snapshot based on the average nominal price as of December 2010 ($19/ton) and total allowance volume available for 2010 compliance.
Source: EPA, 2011 and CantorCO2e Market Price Index, 2011

NO_x Allowance Markets in 2010

The 2010 CAIR NO_x ozone season allowance market continued its price decline from the previous year closing at the end of December at $30 per ton (see Figure 12). The annual NO_x allowance price, as reported by the CantorCO2e Market Price Index, climbed briefly to $716 early in 2010 and then declined to $325 per ton by the end of the year.

Figure 12: NO_x Annual and Ozone Season Allowance Spot Price (Prompt Vintage), January — December 2010



Note: Prompt vintage is the vintage for the current compliance year.
Source: EPA, 2011 and CantorCO2e Market Price Index, 2011

In 2010, the second year of the CAIR ozone season and annual NO_x programs, CAIR sources emitted about 594,000 tons of NO_x during the ozone season (May through September), a 20 percent increase from 2009 levels, but still below the overall budget. CAIR sources emitted about 31,000 tons less than their overall ozone season budget, resulting in about 415,000 banked allowances. Not surprisingly, the downward tendency of ozone season allowance prices continued through most of 2010. Emissions of CAIR annual NO_x were 1.4 million tons, about 82,000 tons less than the overall budget. The CAIR annual NO_x bank grew to more than 400,000 allowances.

Generally, sources in a cap and trade program may consider several emission reduction alternatives and are allowed to trade allowances as part of their compliance strategies. By allowing trades, the overall market can achieve emission targets at a lower cost than through a command and control program because abatement costs are not the same for all sources. A market for emission allowances will emerge, and the allowance price will reflect the marginal cost of emission reductions. Emission control decisions will be made based on the cost of control options relative to the market price of allowances. The allowance price motivates those who have relatively low cost opportunities for emission reductions to make those investments and then sell their surplus allowances to those with higher marginal abatement costs. Looking at the CAIR NO_x ozone season allowance market, it has been EPA's expectation that the CAIR annual NO_x cap would be the binding constraint and absorb most of the capital costs of controls (i.e., SCRs), while the NO_x ozone season allowance prices would primarily be driven by operating costs. As expected, the current CAIR NO_x allowance prices are below the total expected control cost. However, in the middle of 2010, CAIR annual NO_x allowance prices dipped below $500 per ton — the variable SCR cost and theoretical floor price — and remained there through the rest of the year.

Transaction Types and Volumes

Allowance transfer activity includes two types of transfers: EPA transfers to accounts and private transactions. EPA transfers to accounts include the initial allocation of allowances by states or EPA, as well as transfers into accounts related to special set-asides. This category does not include transfers due to allowance retirements. Private transactions include all transfers initiated by authorized account representatives for any compliance or general account purposes.

To help better understand the trends in market performance and transfer history, EPA classifies private transfers of allowance transactions into two categories:

- Transfers between separate and distinct economic entities, which may include companies with contractual relationships such as power purchase agreements, but excludes parent-subsidiary types of relationships. These transfers are categorized broadly as "economically significant trades."
- Transfers within a company or between related entities (e.g., holding company transfers between a unit compliance account and any account held by a company with an ownership interest in the unit).

While all transactions are important to proper market operation, EPA follows trends in the economically significant transaction category with particular interest because these transactions represent an actual exchange of assets between unaffiliated participants. In 2010, about a third of each program's traded allowances were exchanged between unrelated parties, often with a broker facilitating the trade (see Table 10).

Brokers play an important role in the emissions allowance markets. They primarily facilitate and conduct trades between willing buyers and sellers, undertaking the direct costs of identifying trading partners and transacting sales at a price acceptable to both parties. In the allowance trading market, the fees charged by brokerage firms are often considered to be transaction costs. These costs associated with buying and selling allowances are generally low.

Table 10: 2010 Allowance Transfers under CAIR and ARP

Program	Transfer Type	Number of Allowances Transferred	Share of Program Allowances Transferred
Allowances Transferred	Distinct Organizations	132,854	36%
	Related Organizations	237,151	64%
Program Allowances Transferred	Distinct Organizations	344,758	39%
	Related Organizations	540,267	61%
CAIR NO_x Annual	Distinct Organizations	3,009,858	33%
	Related Organizations	6,056,910	66%

Note: Due to rounding, percentages shown may not add up to 100%.
Source: EPA, 2011