Clean Air Interstate Rule
2009 Emission, Compliance and Market Analyses

Program Basics

The Clean Air Interstate Rule (CAIR) was designed to address interstate transport of ozone and fine particulate matter (PM$_{2.5}$) pollution. To do so, CAIR required certain states to limit annual emissions of nitrogen oxides (NO$_x$) and sulfur dioxide (SO$_2$), which contribute to the formation of ozone and PM$_{2.5}$. It also required certain states to limit ozone season NO$_x$ emissions which contribute to the formation of ozone during the summer ozone season. CAIR developed three separate cap and trade programs that could be used to achieve the required reductions — the CAIR NO$_x$ ozone season trading program, the CAIR annual NO$_x$ trading program, and the CAIR SO$_2$ trading program. The CAIR NO$_x$ ozone season and annual programs began in 2009, while the CAIR SO$_2$ annual program began in 2010. The reduction in ozone and PM$_{2.5}$ formation resulting from implementation of the CAIR programs provides health benefits as well as improved visibility in national parks and improved stream quality in the eastern U.S.

Litigation and the 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.

EPA is committed to issuing rules to replace 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. EPA has developed a proposed Transport Rule which, if finalized as proposed, would replace CAIR in 2012. The proposed rule was signed in July 2010, and is available online at <http://epa.gov/airtransport/>.

2009 Progress Reports

EPA is releasing a series of reports over several months summarizing the first year of CAIR implementation, including the transition from the ozone season NO$_x$ Budget Program (NBP). A previous online report presented 2009 data on NO$_x$ and SO$_2$ emission reductions and compliance results for both NO$_x$ programs. This report evaluates progress under CAIR by analyzing emission reductions, compliance results, and market activity in 2009. A future report will compare changes in emissions to changes in environmental indicators.

NO$_x$ Annual and Ozone Season Programs

The CAIR NO$_x$ annual program generally applies to large electric generating units (EGUs) — boilers, turbines, and combined cycle units used 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 steam primarily for internal use and were 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.

At a Glance: CAIR in 2009

**Ozone Season NO$_x$ Emissions**: 495,198 tons
- 21 percent below 2009 cap
- 28 percent lower than in 2008 (the CAIR monitoring training year)

**Annual NO$_x$ Emissions**: 1,311,986 tons
- 21 percent below 2009 cap
- 43 percent lower than in 2008 (the CAIR monitoring training year)

**Ozone Season and Annual NO$_x$ Compliance**: Nearly 100 percent
- Only one facility exceeded its allowed emissions under each CAIR NO$_x$ program.

**SO$_2$ Program Emissions**: 5,000,000 tons
- 2009 was the monitoring training year for the CAIR SO$_2$ program
The CAIR NO\textsubscript{x} ozone season requirements apply to all states from the former NBP except Rhode Island, and to six additional eastern states (Arkansas, Florida, Iowa, Louisiana, Mississippi, and Wisconsin). In addition, while only parts of Alabama, Michigan, and Missouri were in the NBP, the CAIR NO\textsubscript{x} ozone season requirements apply to these states in their entirety. The CAIR NO\textsubscript{x} annual and CAIR SO\textsubscript{2} requirements, which address PM\textsubscript{2.5}, apply in all of the CAIR NO\textsubscript{x} ozone season states except Connecticut, Massachusetts, and Arkansas, and also in Texas and Georgia. These areas are shown in Figure 1. In a November 2009 rule, EPA stayed the effectiveness of CAIR for Minnesota, which had previously been identified as significantly contributing to nonattainment of PM\textsubscript{2.5} ambient air quality standards in downwind states. For purposes of the 2009 Progress Reports, EPA is excluding Minnesota sources and emissions.

**Figure 1: Transition from the NBP to CAIR**

Note: In a November 2009 rule, EPA stayed the effectiveness of CAIR for Minnesota, which had previously been among the states controlled for fine particles.
Source: EPA, 2010

### Affected Units

In 2009, there were 3,279 EGUs and industrial facility units in the CAIR NO\textsubscript{x} ozone season program and 3,321 affected units in the CAIR NO\textsubscript{x} annual program (see Figure 2). 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 1). This covers a range of unit types, including units that operate every day or nearly every day 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 some years.

Of the units covered by the NBP in 2008, 172 were not subsequently covered by the 2009 CAIR NO\textsubscript{x} ozone season program.

As part of CAIR implementation, 2008 was a “training year” for NO\textsubscript{x} monitoring. Units participating in the two CAIR NO\textsubscript{x} trading programs were required to monitor and report their emissions, but were not required to hold allowances for compliance. The reported emissions and heat input values from 2008 provide a baseline with which to assess future reductions (see Table 1).
Table 1: Comparison of NOx Emissions, Heat Input, and NOx Emission Rates for all CAIR Sources

<table>
<thead>
<tr>
<th></th>
<th>Ozone Season NOx Mass Emissions (thousand tons)</th>
<th>Ozone Season Heat Input (billion MMBtu, or quads)</th>
<th>Ozone Season NOx Emission Rate (lb/MMBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>625</td>
<td>442</td>
<td>6.14</td>
</tr>
<tr>
<td>Gas</td>
<td>34</td>
<td>33</td>
<td>1.40</td>
</tr>
<tr>
<td>Oil</td>
<td>28</td>
<td>19</td>
<td>0.28</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>2</td>
<td>0.03</td>
</tr>
<tr>
<td>Total</td>
<td>689</td>
<td>495</td>
<td>7.85</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Annual NOx Mass Emissions (thousand tons)</th>
<th>Annual Heat Input (billion MMBtu, or quads)</th>
<th>Annual NOx Emission Rate (lb/MMBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009</td>
<td>2008</td>
</tr>
<tr>
<td>Coal</td>
<td>2,154</td>
<td>1,184</td>
<td>16.32</td>
</tr>
<tr>
<td>Gas</td>
<td>95</td>
<td>91</td>
<td>4.08</td>
</tr>
<tr>
<td>Oil</td>
<td>47</td>
<td>33</td>
<td>0.45</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>4</td>
<td>0.08</td>
</tr>
<tr>
<td>Total</td>
<td>2,302</td>
<td>1,312</td>
<td>20.93</td>
</tr>
</tbody>
</table>

Notes:
- Tons are rounded to the nearest 1,000 and the heat input values are rounded to the nearest 10 million MMBtus. Totals in final row may not equal the sum of individual rows due to rounding.
- EPA data in Table 1 and used elsewhere in this report are current as of June 7, 2010, and may differ from past or future reports as a result of resubmissions by sources and ongoing data quality assurance activities.
- The emission rate is based on dividing total reported emissions for each fuel category by the total heat input reported for that category, and then rounding the emission rate to the nearest 0.01 lb/MMBtu. The average emission rate expressed for the total uses the heat input-weighted average for the fuel categories.
- Although fuel type, as shown here, is based on the monitoring plan primary fuel designation submitted to EPA, many units burn multiple fuels. “Other” fuel refers to units that burn fuels such as waste, wood, petroleum coke, or tire-derived fuel.
- Source: EPA, 2010

What Is Heat Input?
Heat input, often expressed in million British thermal units (MMBtu), is a measure of the energy content of fuel. It is standardized across fuel sources to allow comparisons among them. For example, a cubic foot of natural gas releases a different amount of energy than a gallon of oil when burned. Heat input also offers an indication of energy demand. For example, high electricity consumption for air conditioning on a hot day will be reflected in high heat input levels at EGUs.

What Is Emission Rate?
Emission rate is the measure of how much pollutant (NOx) is emitted from a combustion unit compared to the amount of energy (heat input) used. In this report, emission rate is expressed as pounds of NOx emitted per MMBtu of heat input. Emission rates enable comparison of a combustion unit’s environmental efficiency given its fuel type and usage. A lower emission rate represents a cleaner operating unit — one that is emitting fewer pounds of NOx per unit of fuel consumed.
Emission Reductions

Ozone Season NOx Reductions

As Figure 3 shows, nearly all the emissions in the NBP region went on to be covered by the CAIR NOx ozone season program. Figure 4 shows that in the first year of CAIR ozone season compliance, former NBP units (i.e., legacy units) continued to reduce their NOx emissions.

Improved emission rates at units with previously installed controls were the primary reason for reduced ozone season NOx emissions in 2009 — the drop in the overall NOx rate alone would have resulted in a reduction of 69 percent of the actual reduction seen, had power demand remained constant. Nine units operated with new NOx control equipment during the 2009 ozone season, and although their collective NOx rate fell by 51 percent, they contributed only 4 percent of the program-wide emission reductions.

Sources entering the CAIR NOx ozone season program — units that were not covered by the NBP in 2008 — also accounted for a large share of the overall emission reductions between 2008 and 2009. The 879 new units reduced their collective NOx rate by 31 percent, from 0.205 lb/MMBtu to 0.142 lb/MMBtu, and their 71 thousand ton reduction in NOx emissions constituted 37 percent of the program’s overall reduction.

Figure 3: Ozone Season NOx Emissions from NBP Sources

Figure 4: Ozone Season Emissions from CAIR NOx Ozone Season Sources, 2008 – 2009

Notes: “Dropout” units are those units that were included in the NBP but did not participate in the 2009 CAIR NOx ozone season program. Source: EPA, 2010
Annual NOx Reductions

As Figure 5 shows, the introduction of the CAIR NOx annual program reduced year-round emissions in 2009 as program participants operated NOx control devices on EGUs outside the summer months. From 2008 to 2009, NOx emissions from units in the CAIR NOx annual program region fell from 2.3 million tons to 1.3 million tons, reflecting a 43 percent reduction in annual NOx emissions and a 36 percent improvement in the rate of NOx emissions. These improvements occurred while power demand (as measured by heat input) from those sources only dropped 10 percent.

**Figure 5: Monthly Emissions and Heat Input from CAIR NOx Annual Program Sources 2008 – 2009**

![Graph showing monthly emissions and heat input from CAIR NOx annual program sources 2008-2009.]

Source: EPA, 2010

Figure 6 demonstrates that the introduction of the CAIR NOx annual program caused a large drop in non-ozone season NOx emission rates as coal-burning units began operating their NOx control equipment year-round. Coal-fired plants, which account for 74 percent of the 2009 heat input, achieved NOx emission rates below 0.20 lb/MMBtu for the entire year. Oil and unconventional units also reduced their emission rates, but if non-coal burning units had kept their 2008 emission rates constant through 2009, annual NOx emissions would still have fallen by 42 percent due to the change in coal-burning plants alone.

**Figure 6: CAIR NOx Annual Program Monthly Emission Rates by Fuel Type**

![Graph showing monthly NOx emission rates by fuel type for CAIR NOx annual program sources 2008-2009.]

Source: EPA, 2010
State-Level NOx Reductions

Between the CAIR monitoring training year in 2008 and 2009, when compliance became mandatory, ozone season NOx emissions fell in every state participating in the CAIR NOx ozone season program (see Figure 7). Units in the seasonal program reduced their overall NOx emissions from 689,000 tons to 495,000 tons. An 11 percent drop in heat input and a 22 percent improvement in NOx rate accounted for this reduction in total summer NOx emissions.

In the 2009 ozone season, the total emissions from participating sources were about 130,000 tons (21 percent) below the regional emission cap. Nineteen states and the District of Columbia had emissions below their allowance budgets, collectively by about 155,000 tons. Another six states (Arkansas, Iowa, Louisiana, Michigan, Mississippi, and Pennsylvania) exceeded their 2009 budgets by a total of about 22,000 tons, indicating that, on an aggregate basis, sources within those states covered a portion of their emissions with allowances either banked from earlier years under the NBP, transferred from an out-of-state account, or purchased from the market.

In 2009, the total emissions from sources in the annual NOx region were about 350,000 tons (also 21 percent) below the regional budget of 1,655,362 tons. All states participating in the program reduced emissions from 2008 levels (see Figure 8). Eighteen states and the District of Columbia had emissions below their allowance budgets, collectively by about 191,000 tons. Another six states (Delaware, Iowa, Louisiana, Michigan, Mississippi, and Pennsylvania) exceeded their 2009 budgets by a total of about 37,000 tons.

Figure 7: Ozone Season Emissions by States Participating in the CAIR NOx Ozone Season Program, 2008 – 2009

Figure 8: Annual Emissions by States Participating in the CAIR NOx Annual Program, 2008 – 2009
CAIR NO\textsubscript{x} Program Compliance

Tables 2 and 3 show how NO\textsubscript{x} allowances were used in 2009. Only one facility did not hold enough allowances to cover its emissions for both the ozone season and annual program. That facility automatically surrendered a 3 for 1 penalty deduction from next year’s allowances for each program.

Banking in 2009

In general, under cap and trade programs, banking allows sources that decrease emissions below the number of allowances they are allocated to save the unused allowances for future use. Banking can produce environmental and health benefits earlier than required and provides an available pool of allowances that could be used to address unexpected events or smooth the transition into deeper emission reductions in future years.

On May 1, 2009, the NBP transitioned to the CAIR NO\textsubscript{x} ozone season program. As part of this process, EPA transferred the bank of NBP allowances to CAIR NO\textsubscript{x} ozone season accounts for use under CAIR. In addition, EPA transferred 2,159 allowances from the primary reserve accounts of two states. In total, EPA transferred 275,367 allowances from the NBP to the CAIR NO\textsubscript{x} ozone season program.

In the 2009 ozone season, CAIR participants were able to bank additional allowances (see Figure 9 on page 8). This continues the NBP’s five consecutive years in which sources achieved greater reductions than the program required.

### Compliance Results

As of June 3, 2010, the reported 2009 ozone season NO\textsubscript{x} emissions by CAIR sources totaled 495,198 tons and annual emissions totaled 1,311,986 tons. Because of variation in rounding conventions, changes due to resubmissions by sources, and allowance compliance issues at certain units, these numbers are higher than the sums of emissions used for reconciliation purposes shown in Tables 2 (ozone season reconciliation) and 3 (annual reconciliation). Therefore, the allowance totals deducted for actual emissions in Tables 2 and 3 differ from the number of emissions shown elsewhere in this report.

#### CAIR NO\textsubscript{x} Ozone Season

- Reported emissions (tons): 495,198
- Rounding and report resubmission adjustments (tons): -199
- Emissions not covered by allowances (tons): -12
- Total allowances deducted for emissions: 494,987

#### CAIR NO\textsubscript{x} Annual Program

- Reported emissions (tons): 1,311,986
- Rounding and report resubmission adjustments (tons): -1,666
- Emissions not covered by allowances (tons): -21
- Total allowances deducted for emissions: 1,310,299

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### Table 2: CAIR Ozone Season Allowance Reconciliation Summary, 2009

<table>
<thead>
<tr>
<th>Total Allowances Held (2003 – 2009 vintages) 887,786</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Affected Facility Accounts</td>
<td>752,378</td>
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<tr>
<td>Other (State Holding, General, and Non-Affected Facility Accounts)</td>
<td>135,408</td>
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<tr>
<td>Allowances Deducted</td>
<td>494,987</td>
</tr>
<tr>
<td>Banked Allowances</td>
<td>392,799</td>
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<tr>
<td>Affected Facility Accounts</td>
<td>257,391</td>
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<tr>
<td>Other (State Holding, General, and Non-Affected Facility Accounts)</td>
<td>135,408</td>
</tr>
<tr>
<td>Penalty Allowance Deductions (2010 Vintage)</td>
<td>12</td>
</tr>
</tbody>
</table>

Note: This table does not include information for sources with ongoing monitoring petitions or applicability issues. The calculations will change as these facilities are reconciled.

Source:  EPA, 2010

### Table 3: CAIR NO\textsubscript{x} Annual Allowance Reconciliation Summary, 2009

<table>
<thead>
<tr>
<th>Total Allowances Held (2009 vintage) 1,653,274</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Affected Facility Accounts</td>
<td>1,576,393</td>
</tr>
<tr>
<td>Other (State Holding, General, and Non-Affected Facility Accounts)</td>
<td>76,881</td>
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<tr>
<td>Allowances Deducted</td>
<td>1,310,299</td>
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<tr>
<td>Banked Allowances</td>
<td>342,975</td>
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<tr>
<td>Affected Facility Accounts</td>
<td>266,094</td>
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<tr>
<td>Other (State Holding, General, and Non-Affected Facility Accounts)</td>
<td>76,881</td>
</tr>
<tr>
<td>Penalty Allowance Deductions (2010 Vintage)</td>
<td>21</td>
</tr>
</tbody>
</table>

Note: This table does not include information for sources with ongoing monitoring petitions or applicability issues. The numbers will change as these facilities are reconciled.

Source:  EPA, 2010
Under the CAIR NO\textsubscript{x} annual program 1,653,274 allowances were issued in 2009. As Figure 9 indicates, after reconciliation, 345,249 allowances remained in the bank to be carried over into 2010.

**Figure 9: 2009 \textit{NO}_x Allowance Allocations and the Allowance Bank**

![Graph showing NO\textsubscript{x} Allowances and Emissions](image)

Notes:
- Allowances allocated may include those issued by states from the base budget, compliance supplement pool (CSP) (available only for the first two years of compliance), and opt-in allowances. Not all budgeted allowances were necessarily issued by the states each year.
- Source: EPA, 2010

**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.

Although many CAIR units with low levels of emissions did not have to use CEMS, the vast majority — over 99 percent of the NO\textsubscript{x} emissions under CAIR — were measured by CEMS. Coal-fired units were required to use CEMS for NO\textsubscript{x} concentration and stack gas flow rate (and if needed, a diluent carbon dioxide or oxygen gas monitor and stack gas moisture measurement) to calculate and record their NO\textsubscript{x} mass emissions. Oil-fired and gas-fired units could use a NO\textsubscript{x} CEMS in conjunction with a fuel flowmeter to determine NO\textsubscript{x} mass emissions. Alternatively, for oil-fired and gas-fired units that either operated infrequently or had very low NO\textsubscript{x} emissions, Part 75 provided low-cost alternatives for CAIR sources to conservatively estimate NO\textsubscript{x} mass emissions.

In all, about 70 percent of CAIR NO\textsubscript{x} ozone season program units used CEMS in 2009, including 100 percent of coal-fired units, 66 percent of gas-fired units, and 29 percent of oil-fired units. In the NO\textsubscript{x} annual program, 73 percent of units used CEMS, including 100 percent of coal-fired units, 70 percent of gas-fired units, and 29 percent of oil-fired units. The relatively low percentage for oil-fired units was consistent with the decline in oil-fired heat input, as most of these units were used infrequently and qualified for reduced monitoring.

**Compliance Options**

Sources could select from a variety of compliance options to meet the emission reduction targets of CAIR in ways that best fit their own circumstances. Compliance options included:

- Installing NO\textsubscript{x} combustion controls, such as low NO\textsubscript{x} burners;
- Installing add-on emission controls, such as Selective Catalytic Reduction (SCR) or Selective Non-Catalytic Reduction (SNCR);
- Using banked allowances or purchasing additional allowances from other market participants that reduced emissions below their allocations;
- Decreasing or stopping generation from units with high NO\textsubscript{x} emission rates, or shifting to lower emitting units, during the ozone season; and
- Using combinations of the above options.

**NO\textsubscript{x} Controls in 2009**

Of the 3,279 units in the CAIR NO\textsubscript{x} ozone season program, approximately 31 percent were non-controlled (see Table 4 on page 9), a share that is similar to that of the NBP in 2008. Nine units from the NBP added controls since 2008, and the new CAIR region included 39 units with controls. Of the 3,321 units in the CAIR NO\textsubscript{x} annual program, 25 percent were non-controlled (see Table 5 on page 9).
Ozone Season High Electric Demand Days

High demand for electricity is closely related to meteorology and is driven primarily by the use of air conditioning on hot days. Periods of hot weather and related high electricity demand often drive peak NOx emissions on a given day. In the 2009 ozone season, emission levels on peak demand days (as measured by megawatt hours of generation) dropped considerably when compared to 2008 (see Figure 10). The average daily NOx emissions during ozone season 2008 was 4,506 tons. In ozone season 2009, the maximum emissions of 4,351 tons occurred on August 10. Not a single day in the 2009 season exceeded the average daily NOx emissions in the 2008 season. Part of the decrease in emissions from 2008 to 2009 is attributable to the decline in demand due to economic conditions.

During high demand days peaking units are called into service. On a typical day during the 2009 ozone season some 1,300 units generated electricity. On the top 10 demand days the average number of units in operation jumped to over 1,800. The average NOx emission rate for the 10 highest ozone season electric demand days in 2009 fell over 10% from 2008. This continues a steady trend of declining emission rates on peak demand days that began in 2003 under the NBP.

Table 4: Ozone Season Program Operating Units by Control Type, 2009

<table>
<thead>
<tr>
<th>Control Type</th>
<th>Number of Units</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustion</td>
<td>978</td>
<td>30%</td>
</tr>
<tr>
<td>Non-controlled</td>
<td>1,015</td>
<td>31%</td>
</tr>
<tr>
<td>Other Control</td>
<td>562</td>
<td>17%</td>
</tr>
<tr>
<td>SCR</td>
<td>587</td>
<td>18%</td>
</tr>
<tr>
<td>SNCR</td>
<td>137</td>
<td>4%</td>
</tr>
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</table>

Table 5: Annual Program Operating Units by Control Type, 2009

<table>
<thead>
<tr>
<th>Control Type</th>
<th>Number of Units</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustion</td>
<td>1,093</td>
<td>33%</td>
</tr>
<tr>
<td>Non-controlled</td>
<td>824</td>
<td>25%</td>
</tr>
<tr>
<td>Other Control</td>
<td>603</td>
<td>18%</td>
</tr>
<tr>
<td>SCR</td>
<td>670</td>
<td>20%</td>
</tr>
<tr>
<td>SNCR</td>
<td>131</td>
<td>4%</td>
</tr>
</tbody>
</table>

Figure 10: Comparison of Daily NOx Emission Levels in CAIR States, 2008 – 2009

Figure 11 illustrates the considerable variation in generation during the 2009 season while the NOx emission rate remains nearly constant. There are several reasons for this behavior. Examining daily megawatt hour output by fuel
type (see Figure 12) reveals that the response to increased demand is primarily met by coal-fired units with add on controls and by gas-fired units. The coal-fired units with SCRs and SNCRs have much lower NOx emission rates than those without add-on controls. Similarly, units fired by gas, in general emit at lower rates than units consuming other fuels. By comparison, the coal units without add-on controls show a more level response curve. Units fired by other fuels, such as oil, produced such a small share of generation that they had little effect on the aggregate daily emissions rate in the 2009 season.

Figure 13 compares daily NOx mass emissions beginning with the NBP 2003-2008 program and extending to the first year of CAIR. Even with the addition of over 700 new CAIR units, ozone season emissions remained nearly level with past years.

Figure 12: Daily Ozone Season Generation in CAIR States by Fuel, 2009

![Graph showing daily ozone season generation by fuel](source)

Source: EPA, 2010

Figure 13: Comparison of Daily NOx Emission Levels in NBP/CAIR States, 2003 – 2009

![Graph comparing daily NOx emissions](source)

Source: EPA, 2010

**Market Activity**

**NOx Allowance Trading in 2009**

The 2009 CAIR NOx ozone season allowance market experienced an 87 percent price decline, beginning at $550 per ton in January and falling to a period-end closing price in December of $73 per ton (see Figure 14). The NOx annual allowance price began 2009 at $2,250 and quickly rose to

Figure 14: NOx Annual and Ozone Season Allowance Spot Price (Prompt Vintage), January – December 2009

![Graph showing NOx spot price](source)

Note: Prompt vintage is the vintage for the “current” compliance year. For example, 2009 vintage allowances were considered the prompt vintage until the true-up period closed at the end of November 2009.

Source: CANTOR CO2e’s Market Price Indicator (MPI), 2010; see <www.emissionstrading.com>
In a cap and trade program, several emission reduction alternatives are available to sources, as part of their compliance strategy, including allowance trading. Because abatement costs are not the same for all sources, the overall market can achieve emission targets at a lower cost through trading than through a command and control program. A market for emission allowances will emerge, and the allowance price will reflect the marginal cost of emission reductions. Emission control decisions will be based on the cost of control options relative to the market price of allowances. The allowance price will motivate those who have relatively low cost opportunities for emission reductions to make those investments and sell their surplus allowances to those with higher marginal abatement costs. Assessing the CAIR NO\textsubscript{x} ozone season allowance market, EPA’s expectation has been that the CAIR annual NO\textsubscript{x} cap would be the binding constraint and would absorb most of the capital costs of controls (e.g., SCRs), while NO\textsubscript{x} emissions from CAIR annual program sources were 1.3 million tons, about 345,000 tons less than the overall budget.

In a cap and trade program, several emission reduction alternatives are available to sources, as part of their compliance strategy, including allowance trading. Because abatement costs are not the same for all sources, the overall market can achieve emission targets at a lower cost through trading than through a command and control program. A market for emission allowances will emerge, and the allowance price will reflect the marginal cost of emission reductions. Emission control decisions will be based on the cost of control options relative to the market price of allowances. The allowance price will motivate those who have relatively low cost opportunities for emission reductions to make those investments and sell their surplus allowances to those with higher marginal abatement costs. Assessing the CAIR NO\textsubscript{x} ozone season allowance market, EPA’s expectation has been that the CAIR annual NO\textsubscript{x} cap would be the binding constraint and would absorb most of the capital costs of controls (e.g., SCRs), while NO\textsubscript{x} emissions from CAIR annual program sources were 1.3 million tons, about 345,000 tons less than the overall budget.

Although 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.

**Table 6: Allowance Transactions**

<table>
<thead>
<tr>
<th>Transaction Types and Volumes</th>
<th>Distinct Entities</th>
<th>Related Entities</th>
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<tbody>
<tr>
<td>CAIR NO\textsubscript{x} Ozone Season Program</td>
<td>99,639</td>
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</tr>
<tr>
<td>CAIR NO\textsubscript{x} Annual Program</td>
<td>335,137</td>
<td>57%</td>
</tr>
<tr>
<td>Related Entities</td>
<td>289,851</td>
<td>74%</td>
</tr>
<tr>
<td>Related Entities</td>
<td>253,509</td>
<td>43%</td>
</tr>
</tbody>
</table>

Source: EPA, 2010

**Role of Brokers and Their Fees**

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 fees are the direct costs associated with buying and selling allowances.

Costs for services are fairly standardized and are generally low compared to the value of allowances, usually within the 1 to 2 percent range of allowance values typically cited in the economics literature.* Because there is sufficient competition among the brokerage houses any attempt at charging fees in excess of market standards would likely be bid down through either existing competition or entry of more businesses able to provide brokerage services. In many instances, larger clients can negotiate fees even lower than market averages. In addition, if a company needs some expert analysis or opinions to maximize the value of its allowances, it may agree to pay additional fees unrelated to the actual execution of the trades.

Emissions allowances and derivatives (i.e., futures contracts) may also be traded on exchanges such as the New York Mer-

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The fees charged for conducting business on exchanges appear to be markedly lower than the fees charged by brokerage firms. On a per ton basis, these exchange fees range from less than $1.00 per ton for seasonal NO\textsubscript{x} to $2.50 per ton for annual NO\textsubscript{x}. These fees are below the broker fees charged for transactions between two parties.

**The CAIR SO\textsubscript{2} Program**

The CAIR SO\textsubscript{2} trading program is intended to reduce ambient SO\textsubscript{2} levels in downwind states by capping emissions in participating eastern states (see Figure 15). The program applies to the same EGU\textsubscripts as the CAIR NO\textsubscript{x} annual program (see Figure 16). Of the 3,321 units in the CAIR SO\textsubscript{2} program, 2,595 (78 percent) were also covered by the Acid Rain Program (ARP) in 2009. The other units are largely fossil generation units that entered SO\textsubscript{2} control under the broader applicability requirements of CAIR. All the CAIR SO\textsubscript{2} program facilities participated in a monitoring and reporting training year in 2009. In 2010, the first year of operation of the CAIR SO\textsubscript{2} trading program, facilities were obligated to hold SO\textsubscript{2} allowances. Since SO\textsubscript{2} allowances from the ARP are used in CAIR, there has been an incentive from 2005–2009 for units to lower SO\textsubscript{2} emissions in order to have allowances under CAIR. Except for a small number of facilities with pending applicability questions, all participating units reported data in 2009. Their total SO\textsubscript{2} emissions were 5.0 million tons.

*Figure 15: The CAIR SO\textsubscript{2} Region*

![Map of the CAIR SO\textsubscript{2} Region](image)

Source: EPA, 2010

*Figure 17: SO\textsubscript{2} Emissions from Sources in the ARP and in the CAIR Annual SO\textsubscript{2} Program Region, 2004 – 2009*

![Bar chart showing SO\textsubscript{2} emissions](image)

Source: EPA, 2010

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

Source: EPA, 2010