



Chapter 3: Emissions Reductions

Ozone Season Nitrogen Oxides (NO_x)

The Acid Rain Program (ARP) and the Clean Air Interstate Rule (CAIR) programs significantly reduced annual SO₂ and NO_x emissions. These reductions occurred while electricity demand (measured as heat input) remained relatively stable, indicating that the reductions in emissions were not driven by decreased electric generation.

These emission reductions represent an overall increase in the environmental efficiency of these sources as power generators installed controls, ran their controls year round, switched to lower emitting fuels, or otherwise reduced their SO₂ and NO_x emissions while meeting the relatively steady electricity demand. Most of the emission reductions since 2005 are from early reduction incentives and stricter emission cap levels under CAIR.

Analysis and Background Information

Nitrogen oxides (NO_x) is made up of a group of highly reactive gases that are emitted from power plants, motor vehicles, as well as other sources. NO_x contributes to the formation of ground-level ozone and fine particle pollution, which cause a variety of adverse human health effects.

The CAIR NO_x ozone season program was established to reduce interstate transport during the summer months (May-September), when ozone formation is highest, and to help eastern U.S. counties attain the 1997 ozone standard.

In general, the states with the highest emitting sources of ozone season NO_x in 2000 have generally seen the greatest reductions under the CAIR NO_x ozone season program. Most of these states are in the Ohio River Valley and are upwind of the areas CAIR was designed to protect and reductions by sources in these states have resulted in important environmental and human health benefits over a large region.

In addition to the CAIR and ARP NO_x programs and the former NBP, current regional and state NO_x emission control programs have also contributed significantly to the ozone season NO_x reductions achieved by sources.

Key Points

Ozone Season NO_x Trends

- Units in the CAIR NO_x ozone season program emitted 470,000 tons in 2013, a 1.6 million ton reduction from 1990 (77 percent reduction), 980,000 tons lower (67 percent reduction) than in 2000 (before implementation of the NBP), 330,000 tons lower than in 2005 (41 percent reduction), and about 40,000 tons lower than in 2012 (8 percent reduction).
- In 2013 CAIR NO_x ozone season emissions were 16 percent below the regional emission budget of 567,744 tons.
- In 2013, 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



<http://www.epa.gov/airmarkets/progress>

820,000 tons in 2005 (before implementation of CAIR) to 480,000 tons in 2013 (41 percent reduction).

Ozone Season NO_x State-by-State Emission Maps

- Between 2005 and 2013, 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 Arkansas and Pennsylvania, where emissions increased by a total of 11,000 tons.
- Nineteen states and D.C. had emissions below their CAIR allowance budgets, collectively by about 120,000 tons. Another six states exceeded their 2013 budgets by a total of about 30,000 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.

Ozone Season NO_x Emission Rates

- In 2013 the NO_x ozone season emission rate fell to 0.13 lb/mmBtu. This indicates a 68 percent reduction from 2000 emission rates, with the majority of reductions from coal-fired units.
- Despite the dramatic decrease in tons of ozone season NO_x emissions, heat input has remained relatively constant, indicating an improvement in emission rate. This is due in large part to greater use of control technology on coal-fired units and increased heat input at natural gas-fired units.

More Information

Visit EPA's Power Plant Emission Trends site for the most up-to-date emissions and control data for sources in CAIR and the ARP <http://www.epa.gov/airmarkets/progress/datatrends/index.html>

Learn more about nitrogen oxides (NO_x) <http://www.epa.gov/air/nitrogenoxides/>

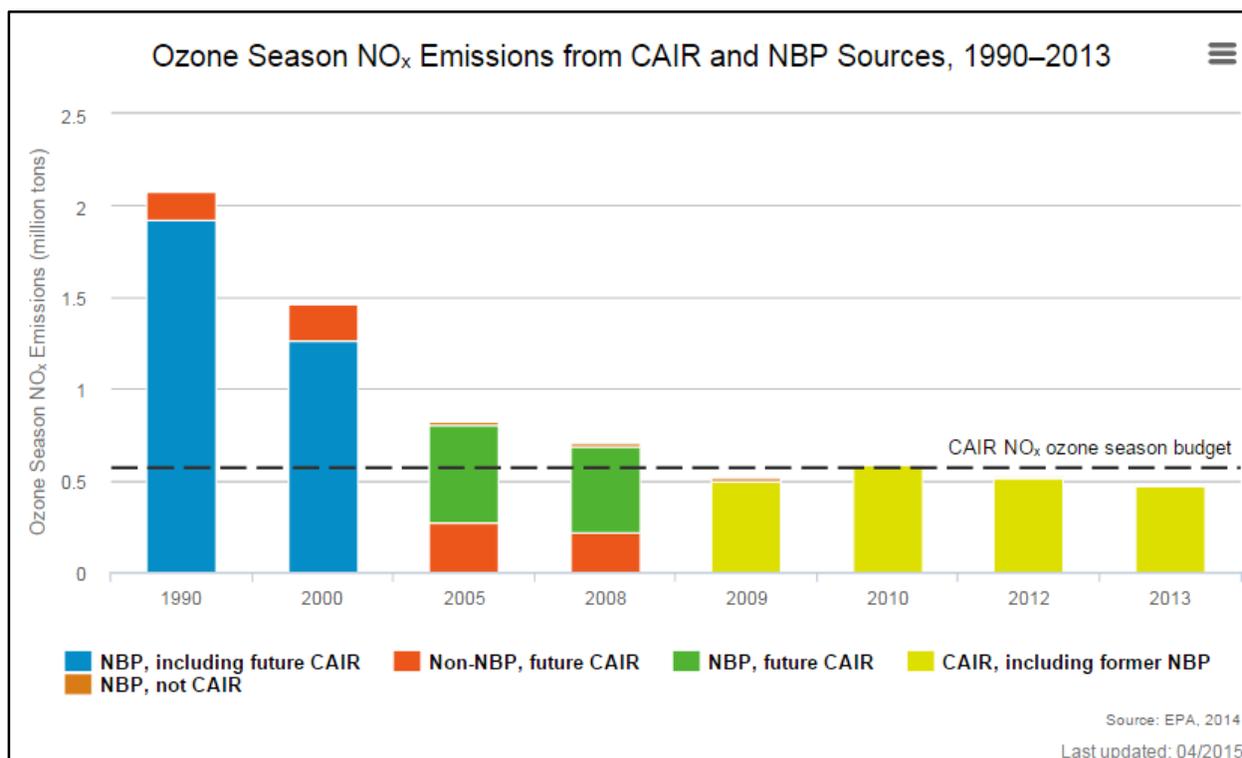
Learn more about Particulate Matter (PM) <http://www.epa.gov/pm/>

Learn more about Ozone <http://www.epa.gov/air/ozonepollution/>



Figures

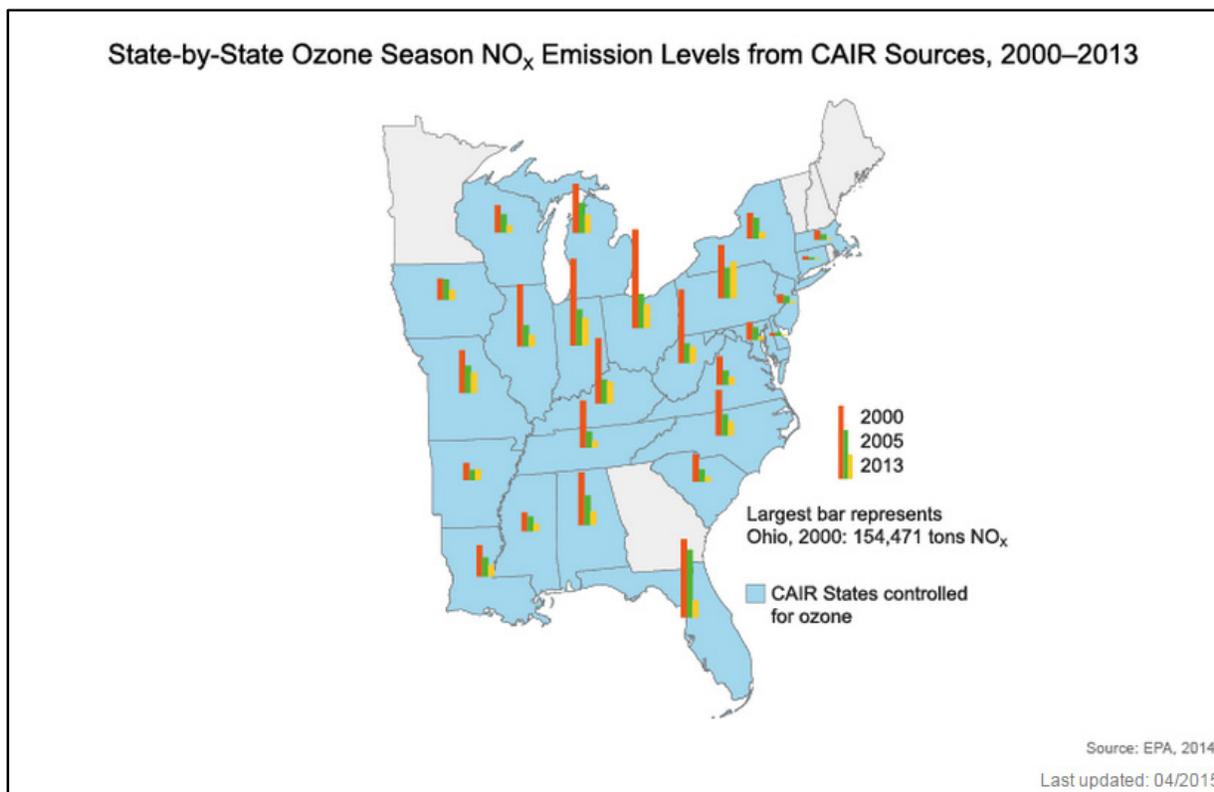
Subtopic: Ozone Season Nitrogen Oxides (NO_x)



Notes:

- For CAIR units not in the NBP, the 2008 emissions were applied retroactively to 1990 and 2000 if the unit operated in the previous year's ozone season.

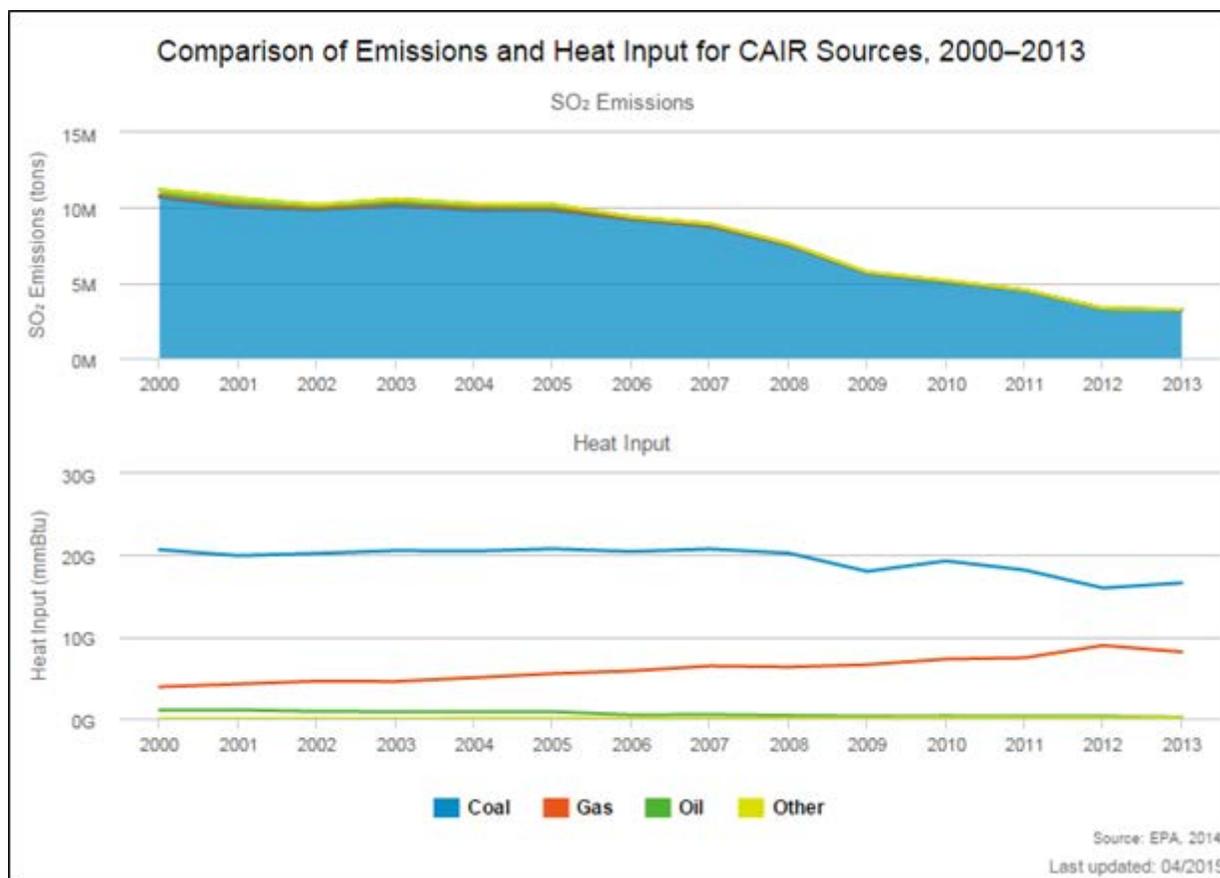
Figure 1. Ozone Season NO_x Emissions from CAIR and NBP Sources, 1990-2013



Notes:

- The 2000 and 2005 ozone season values reflect data that were reported under other programs. 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.

**Figure 2. State-by-State Ozone Season NO_x Emission Levels
from CAIR Sources, 2000-2013**



Notes:

- The data shown here include emissions and heat input data for 2000 and 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 the 2008 training year were substituted.
- Fuel type represents primary fuel type; units might combust more than one fuel.
- Unless otherwise noted, EPA data are current as of June 2014, and may differ from past or future reports as a result of resubmissions by sources and ongoing data quality assurance activities.

Figure 3. Comparison of Emissions and Heat Input for CAIR Sources, 2000-2013



CAIR Ozone Season NO_x Trends

Primary Fuel	NO _x Emissions (thousand tons)					NO _x Rate (lb/mmBtu)					Heat Input (billion mmBtu)				
	2000	2005	2009	2010	2013	2000	2005	2009	2010	2013	2000	2005	2009	2010	2013
Coal	1,395	692	442	527	428	0.45	0.22	0.17	0.18	0.18	6.17	6.30	5.21	5.85	4.81
Gas	78	58	39	49	37	0.17	0.08	0.05	0.05	0.04	0.92	1.54	1.58	2.02	2.08
Oil	66	57	13	16	7	0.27	0.25	0.17	0.15	0.11	0.48	0.45	0.15	0.22	0.12
Other	1	2	2	2	3	0.15	0.17	0.14	0.12	0.10	0.02	0.02	0.02	0.04	0.05
Total	1,541	809	495	594	474	0.41	0.20	0.14	0.15	0.13	7.59	8.31	6.98	8.13	7.07

Source EPA, 2014
Last updated: 04/2015

Notes:

- The data shown here include emissions and heat input data for 2000 and 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 the 2008 training year were substituted.
- 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.
- Unless otherwise noted, EPA data are current as of June 2014, and may differ from past or future reports as a result of resubmissions by sources and ongoing data quality assurance activities.

Figure 4. CAIR NO_x Ozone Season Trends