Chapter 3: Emissions Reductions

Nitrogen Oxides (NO_x)

The Acid Rain Program (ARP) and the Clean Air Interstate Rule (CAIR) programs significantly reduced annual SO_2 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 SO_2 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 health effects.

Overall, NO_x emissions have declined dramatically under the ARP, former NBP and CAIR programs, with the majority of reductions from coal-fired units. Other programs—such as regional and state NO_x emission control programs—also contributed significantly to the annual NO_x reductions achieved by sources in 2013.

Key Points

Annual NO_x Trends

- Units in the ARP NO_x program emitted 1.7 million tons of NO_x in 2013, indicating that ARP sources reduced emissions by 6.4 million tons from the projected level in 2000 without the ARP, and over three times the Title IV NO_x emission reduction objective.
- In 2013, the fifth year of operation of the CAIR NO_x annual trading program, sources in both the CAIR NO_x annual program and the ARP together emitted 1.7 million tons, a reduction of 4.7 million tons (73 percent reduction) from 1990 levels, 3.4 million tons (66 percent reduction) from 2000, and 1.9 million tons (53 percent reduction) from 2005 levels.
- Emissions from CAIR NO_x annual program sources alone were about 1.2 million tons in 2013. This is about 320,000 tons (21 percent) below the 2013 CAIR NO_x annual program's regional budget of 1,490,264 tons and 2.5 million tons (68 percent) lower than in 2005.

Annual NO_x State-by-State Emission Maps

- All states participating in the ARP and CAIR NO_x annual program decreased their NO_x emissions from 1990 to 2013 as well as from 2005 to 2013.

- Seventeen states and D.C. had emissions below their CAIR 2013 allowance budgets, collectively by about 370,000 tons. Another seven states exceeded their 2013 budgets by a total of about 58,000 tons. This indicates 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.
- Overall, in 2013 the total NO_x emissions from participating sources were about 320,000 tons below the regional emission budget of 1,490,264 tons.

Annual NO_x Emission Rates

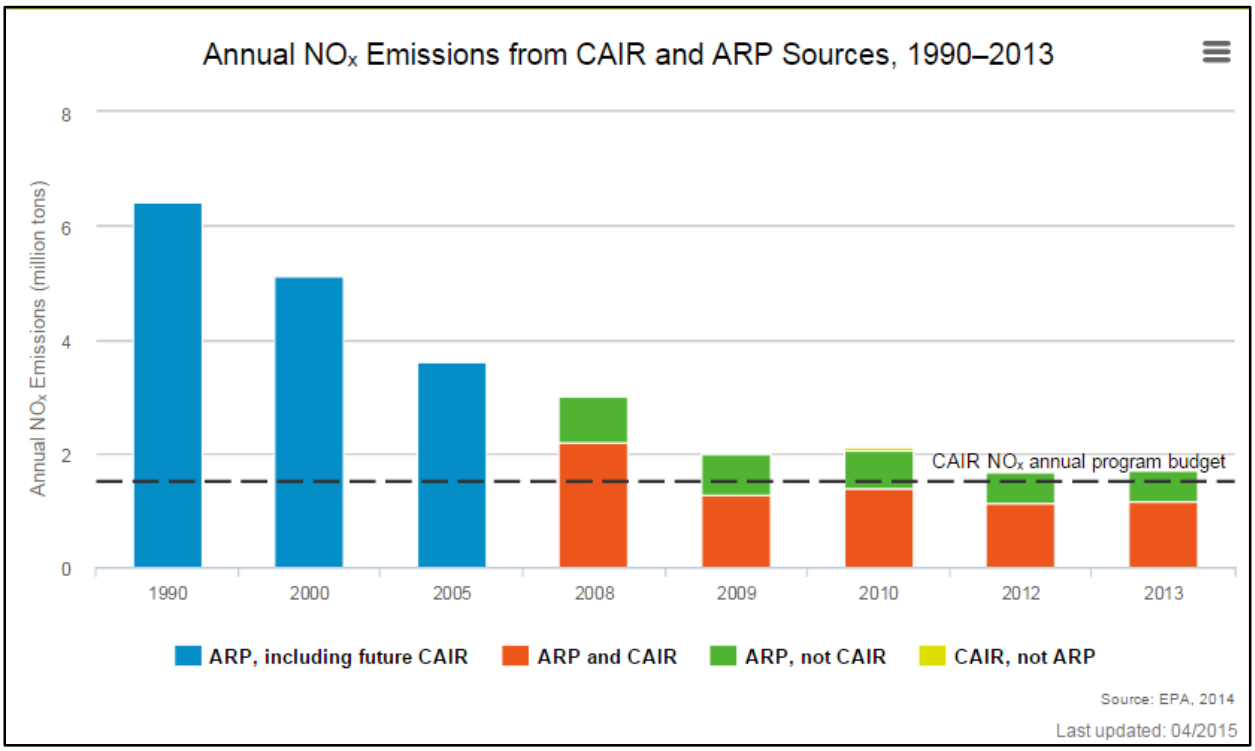
- In 2013 the CAIR and ARP annual NO_x emission rate was 0.14 lbs/mmBtu, a 49 percent reduction from 2005.
- Despite the dramatic decrease in tons of NO_x emission, heat input has remained relatively steady, indicating an improvement in emission rate (see table). This is due in large part to greater 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: Nitrogen Oxides (NO_x)



Notes:

- 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.

Figure 1. Annual NO_x Emissions from CAIR and ARP Sources, 1990-2013

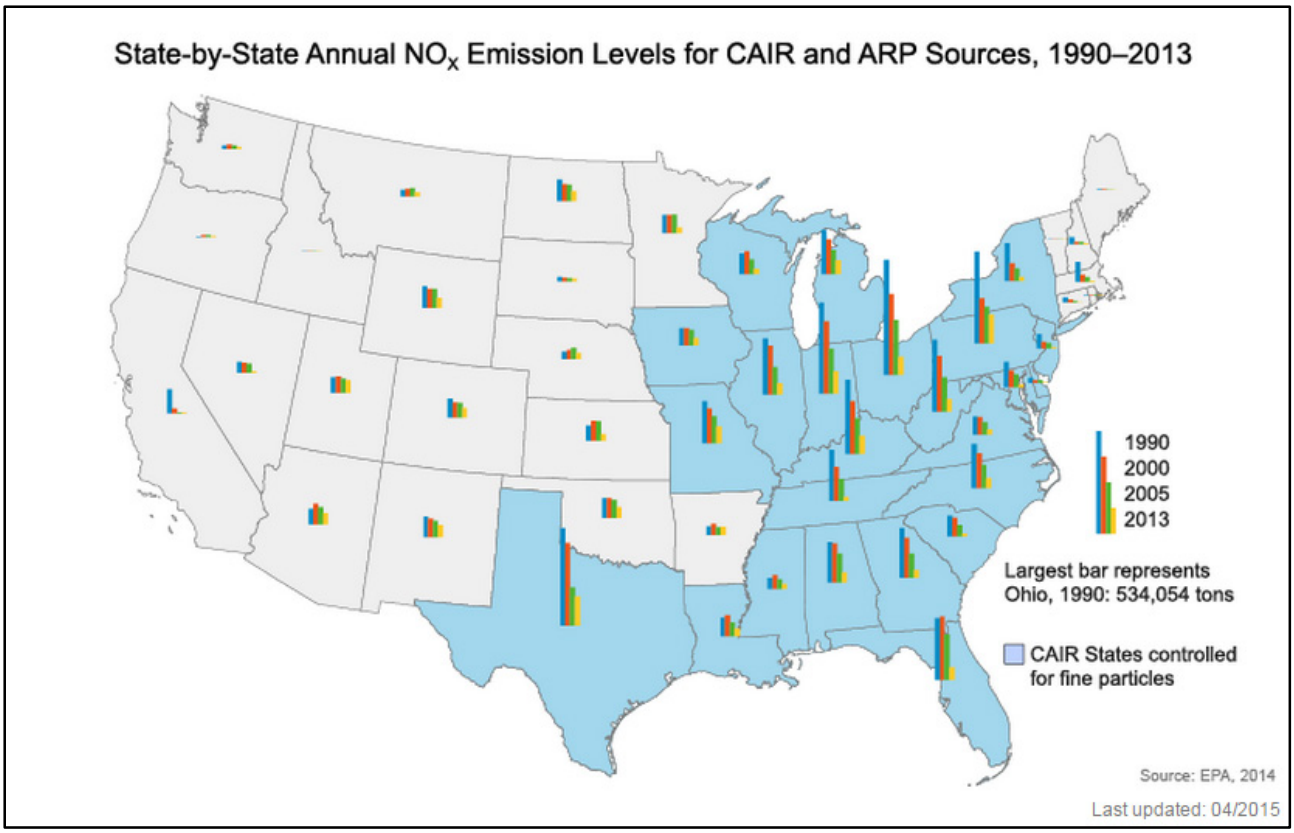
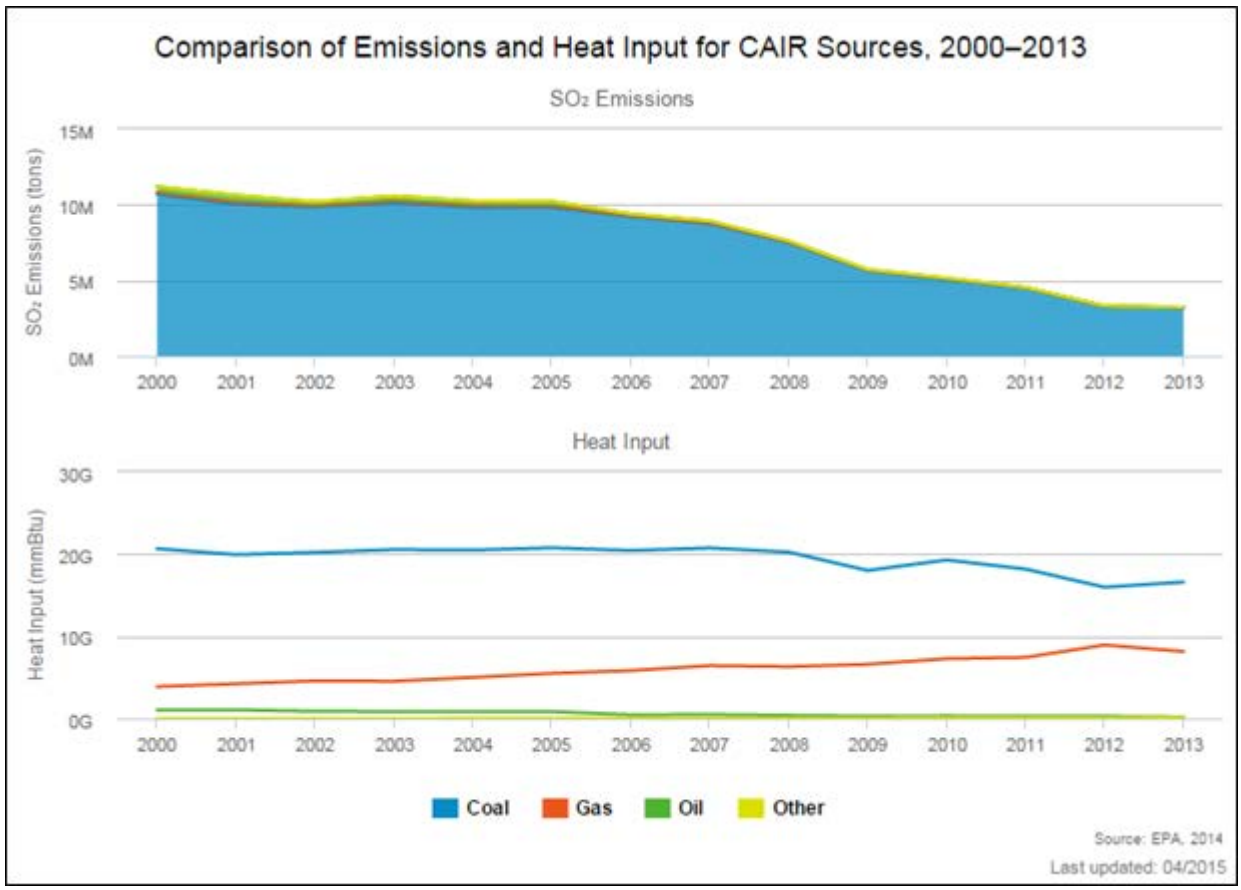


Figure 2. State-by-State Annual NO_x Emission Levels for CAIR and ARP Sources, 1990-2013



Notes:

- The data shown here for the annual programs 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 2000 and 2005.
- 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 of 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 and ARP Annual NO_x Trends

	NO_x Emissions (thousand tons)					NO_x Rate (lb/mmBtu)					Heat Input (billion mmBtu)				
Primary Fuel	2000	2005	2009	2010	2013	2000	2005	2009	2010	2013	2000	2005	2009	2010	2013
Coal	4,587	3,356	1,848	1,923	1,573	0.44	0.32	0.20	0.20	0.19	20.67	20.77	18.28	19.30	16.61
Gas	354	167	143	150	128	0.18	0.06	0.04	0.04	0.03	3.88	5.49	6.80	7.28	8.16
Oil	162	104	25	24	11	0.31	0.25	0.17	0.15	0.11	1.06	0.84	0.29	0.33	0.21
Other	2	6	5	7	7	0.25	0.42	0.12	0.13	0.11	0.01	0.03	0.09	0.10	0.14
Total	**5,104**	**3,633**	**2,020**	**2,103**	**1,720**	**0.40**	**0.27**	**0.16**	**0.16**	**0.14**	**25.61**	**27.13**	**25.46**	**27.00**	**25.10**

Source EPA, 2014

Last updated: 04/2015

Notes:

- The data shown here includes 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 of future reports as a result of resubmissions by sources and ongoing data quality assurance activities.

Figure 4. CAIR and ARP Annual NO_x Trends