

# POWER SECTOR PROGRAMS PROGRESS REPORT

2021

- Program Basics
- Regulated Emissions Sources
- Emission Reductions
- Program Compliance
- Emission Controls & Monitoring
- Market Activity



## Executive Summary

The Power Sector Programs Progress Report provides annual updates on EPA’s regulatory programs to reduce emissions in the power sector. Part 1, *Program Implementation, Compliance, and Emissions Trends*, covers program basics, and provides annual updates on pollution controls, monitoring methods, and changes in emissions. Part 2, *Environmental Results and Affected Communities*, will cover the air quality and ecosystem response to these reductions, and also feature a new section on community impacts. This report will be released after environmental data for 2021 become available.

Under the Clean Air Act, EPA implements regulations to reduce emissions from power plants, including the Acid Rain Program (ARP), the Cross-State Air Pollution Rule (CSAPR), the CSAPR Update, the Revised CSAPR Update, and the Mercury and Air Toxics Standards (MATS). These programs require fossil fuel-fired electric generating units to reduce emissions of sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), and hazardous air pollutants including mercury (Hg) to protect human health and the environment. This reporting year marks the seventh year of CSAPR implementation, the fifth year of CSAPR Update implementation, the first year of Revised CSAPR Update implementation, the twenty-seventh year of the ARP, and the fifth year of MATS implementation. This report summarizes annual progress through 2021, highlighting data that EPA systematically collects on emissions for all five programs and on compliance for the ARP and the CSAPR programs. Commitment to transparency and data availability is a hallmark of these programs and a cornerstone of their success.

SO<sub>2</sub>, NO<sub>x</sub>, and hazardous air pollutants (HAPs), including mercury, are fossil fuel combustion byproducts that affect public health and the environment. SO<sub>2</sub> and NO<sub>x</sub>, and their sulfate and nitrate byproducts, are transported downwind and deposited as acid rain which can be harmful to sensitive ecosystems in many areas of the country. These pollutants also contribute to the formation of fine particles (sulfates and nitrates) and ground-level ozone that are associated with significant human health effects and regional haze. Atmospheric mercury deposition accumulates in fish to levels of concern for human health and the health of fish-eating wildlife.

The ARP, CSAPR, CSAPR Update, Revised CSAPR Update, and MATS have delivered substantial reductions in power sector emissions of SO<sub>2</sub>, NO<sub>x</sub>, and hazardous air pollutants, along with significant improvements in air quality and the environment. In addition to the requirements of the power sector emission control programs described in this report, a variety of power industry trends have contributed to further declines of SO<sub>2</sub>, NO<sub>x</sub>, and hazardous air pollutant emissions.

EPA data in this report are current as of July 2022 and may differ from past or future reports because of data resubmissions by sources and ongoing data quality assurance activities.



### 2021 Program Implementation, Compliance, and Emissions Trends at a Glance

- **Annual SO<sub>2</sub> emissions:**  
CSAPR – 592,000 tons (93 percent below 2005)  
ARP – 936,000 tons (94 percent below 1990)
- **Annual NO<sub>x</sub> emissions:**  
CSAPR – 440,000 tons (80 percent below 2005)  
ARP – 763,000 tons (85 percent below 2000)
- **CSAPR ozone season NO<sub>x</sub> emissions:** 242,000 tons (46 percent below 2015)
- **Compliance:** 100 percent compliance for in the market-based ARP and CSAPR emissions trading programs
- **Emissions reported under MATS:**  
Mercury – 3.0 tons (90 percent below 2010)

### 2020 Environmental Results at a Glance

The following data are from 2020 and will be updated in Part 2 of the Progress Report, *Environmental Results and Affected Communities*, when 2021 data become available:

- **Ambient particulate sulfate concentrations:** The eastern United States has shown substantial improvement, decreasing 76 to 79 percent between 2000-2002 and 2018–2020.
- **Ozone NAAQS attainment:** Based on 2018-2020 data, 18 of the 22 areas in the East originally designated as nonattainment for the 2008 ozone NAAQS are now meeting the standard, while three of the remaining four areas have shown improvement.
- **PM<sub>2.5</sub> NAAQS attainment:** Based on 2018-2020 data, all 16 areas in the East originally designated as nonattainment for the 2006 24-hour PM<sub>2.5</sub> NAAQS are now meeting the standard.
- **Wet sulfate deposition:** All areas of the eastern U.S. have shown significant improvement with an overall 70 percent reduction in wet sulfate deposition from 2000-2002 to 2018–2020.
- **Levels of acid neutralizing capacity (ANC):** This indicator of aquatic ecosystem recovery improved (i.e., increased) significantly from 1990 levels at lake and stream monitoring sites in the Adirondack region, New England, and the Catskill mountains.



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## Chapter 1: Program Basics

The Acid Rain Program (ARP), the Cross-State Air Pollution Rule (CSAPR), the CSAPR Update, and the Revised CSAPR Update are implemented through trading programs<sup>1</sup> designed to reduce emissions of sulfur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>) from power plants. Established under Title IV of the 1990 Clean Air Act Amendments, the ARP was a landmark nationwide emissions trading program, with a goal of reducing the emissions that cause acid rain. The success of the program in achieving significant emission reductions in a cost-effective manner led to the application of the market-based emissions trading tool for other regional environmental problems, namely interstate air pollution transport, or pollution from upwind emission sources that impacts air quality in downwind areas. The interstate transport of pollution makes it difficult for downwind states to meet health-based air quality standards for regional pollutants, particularly fine particulates (PM<sub>2.5</sub>) and ozone. EPA first employed trading to address regional pollution in the NO<sub>x</sub> Budget Trading Program (NBP), which helped northeastern states address the interstate transport of NO<sub>x</sub> emissions causing ozone pollution in northeastern states. Next, the NBP was effectively replaced by the ozone season NO<sub>x</sub> program under the Clean Air Interstate Rule (CAIR), which required further summertime NO<sub>x</sub> emission reductions from the power sector, and also required annual reductions of NO<sub>x</sub> and SO<sub>2</sub> emissions to address PM<sub>2.5</sub> transport. In response to a court decision on CAIR, CSAPR replaced CAIR beginning in 2015 and continued to reduce annual SO<sub>2</sub> and NO<sub>x</sub> emissions, as well as ozone season NO<sub>x</sub> emissions, to facilitate attainment of the 1997 annual PM<sub>2.5</sub>, the 2006 24-hour PM<sub>2.5</sub>, and the 1997 8-hour ozone National Ambient Air Quality Standards (NAAQS). Implementation of the CSAPR Update began in 2017. The CSAPR Update further reduces ozone season NO<sub>x</sub> emissions to help states attain and maintain a newer ozone NAAQS established in 2008. Implementation of the Revised CSAPR Update began in 2021 and resolves 21 states' outstanding interstate transport obligations for the 2008 ozone NAAQS. Most recently, in February 2022, the EPA proposed additional reductions in ozone-forming emissions of NO<sub>x</sub> to facilitate attainment and maintenance of the more stringent 2015 ozone NAAQS.

The Mercury and Air Toxics Standards (MATS) set limits on emissions of hazardous air pollutants from power plants. EPA published the final standards in February 2012, and the compliance requirements generally went into effect in April 2015, with extensions for some plants until April 2016 and a small number until April 2017. As such, 2021 is the fifth full year for which most sources covered by MATS have reported emissions data to the EPA.

### Highlights

#### Acid Rain Program (ARP): 1995 - present

- The ARP began in 1995 and covers fossil fuel-fired power plants across the contiguous United States. The ARP was established under Title IV of the 1990 Clean Air Act Amendments and is designed to reduce SO<sub>2</sub> and NO<sub>x</sub> emissions, the primary precursors of acid rain.

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<sup>1</sup> These emissions trading programs are also known as “allowance trading programs” or “cap-and-trade” programs.



- The ARP’s market-based SO<sub>2</sub> emissions trading program sets an annual cap on the total amount of SO<sub>2</sub> that may be emitted by power plants throughout the contiguous U.S. The final annual SO<sub>2</sub> emissions cap was set at 8.95 million tons in 2010, a level of about one-half of the emissions from the power sector in 1980.
- NO<sub>x</sub> reductions under the ARP are achieved through a rate-based approach that applies to a subset of coal-fired power plants.

### **Cross-State Air Pollution Rule (CSAPR): 2015 - present**

- CSAPR addresses regional interstate transport of fine particle (PM<sub>2.5</sub>) and ozone pollution for the 1997 ozone and PM<sub>2.5</sub> NAAQS and the 2006 PM<sub>2.5</sub> NAAQS. In 2015, CSAPR required reductions in annual emissions of SO<sub>2</sub> and NO<sub>x</sub> from power plants in 23 eastern states and reductions of NO<sub>x</sub> emissions during the ozone season from power plants in 25 eastern states, covering 28 states in all.
- CSAPR includes four separate emissions trading programs to achieve these reductions: the CSAPR SO<sub>2</sub> Group 1 and Group 2 trading programs, the CSAPR NO<sub>x</sub> Annual trading program, and the CSAPR NO<sub>x</sub> Ozone Season Group 1 trading program.

### **Cross-State Air Pollution Rule Update (CSAPR Update): 2017 - present**

- The CSAPR Update was developed to address regional interstate transport for the 2008 ozone NAAQS and to respond to the July 2015 court remand of certain CSAPR ozone season requirements.
- As of May 2017, the CSAPR Update began further reducing ozone season NO<sub>x</sub> emissions from power plants in 22 states in the eastern U.S.
- The CSAPR Update achieves these reductions through the CSAPR NO<sub>x</sub> Ozone Season Group 2 trading program.

### **Revised Cross-State Air Pollution Rule Update (Revised CSAPR Update): 2021 – present**

- The Revised CSAPR Update was developed to resolve 21 states’ outstanding interstate transport obligations for the 2008 ozone NAAQS and to respond to the September 2019 court remand of the 2016 CSAPR Update.
- Beginning in June 2021, further emission reductions were required at power plants in 12 of the 21 states for which the CSAPR Update was previously found to be only a partial remedy. These reductions are based on optimization of existing, already-installed selective catalytic reduction (SCR) and selective non-catalytic reduction (SNCR) controls beginning in the 2021 ozone season, and installation or upgrade of enhanced NO<sub>x</sub> combustion controls beginning in the 2022 ozone season. EPA will also adjust these 12 states’ ozone season emission budgets through 2024 to incentivize the continued use of these control technologies.
- The Revised CSAPR Update achieves these reductions through the CSAPR NO<sub>x</sub> Ozone Season Group 3 trading program.





### CSAPR, CSAPR Update, and Revised CSAPR Update Budgets

- The total CSAPR, CSAPR Update, and Revised CSAPR Update budget for each of the six trading programs equals the sum of the individual state budgets for those states affected by each program. The CSAPR Update replaced the original CSAPR ozone season NO<sub>x</sub> program for most states. Most recently, the Revised CSAPR Update replaced the CSAPR Update ozone season NO<sub>x</sub> program for twelve states. The total budget for each program was set at the following level in 2021:
  - SO<sub>2</sub> Group 1 – 1,372,631 tons
  - SO<sub>2</sub> Group 2 – 597,579 tons
  - NO<sub>x</sub> Annual – 1,069,256 tons
  - NO<sub>x</sub> Ozone Season Group 1 – 24,041 tons<sup>2</sup>
  - NO<sub>x</sub> Ozone Season Group 2 – 143,408 tons<sup>3</sup>
  - NO<sub>x</sub> Ozone Season Group 3 – 131,430 tons

### Mercury and Air Toxics Standards (MATS)

- EPA announced standards to limit mercury, acid gases, and other toxic pollution from power plants in December 2011 (published in February 2012). EPA provided the maximum 3-year compliance period, so sources were generally required to comply no later than April 16, 2015. Some sources obtained a one-year extension from their state permitting authority, allowed under the CAA, and so were required to comply with the final rule by April 16, 2016.
- Units subject to MATS must comply with emission rate limits for certain hazardous air pollutants (or surrogates). There are several ways to demonstrate compliance, including the use of continuous monitoring or through periodic measurement of emissions. Some units may choose to demonstrate compliance through periodic performance tests.
- This progress report only provides data from affected sources that submitted hourly emissions data in 2021. Mercury emissions data are not available for 79 low emitting electric generating units.

## Background Information

### Power Sector Trends

The widespread and dramatic emission reductions in the power sector over the last few decades have come about from several factors, including changes in markets for fuels and electricity as well as regulatory programs.<sup>4</sup> While most coal-fired electricity generation comes from sources with state-of-the-art emission controls, broad industry shifts from coal-fired generation to gas-fired generation, as well as increases in zero-emitting generation sources, also have reduced power sector emissions. Market factors, modest demand growth, and policy and regulatory efforts have resulted in a notable

<sup>2</sup> Since the start of CSAPR Update in 2017, the CSAPR NO<sub>x</sub> Ozone Season Group 1 program applies only to sources in Georgia.

<sup>3</sup> Since the start of Revised CSAPR Update in 2021, the CSAPR Update Group 2 program applies only to sources in ten states.

<sup>4</sup> EIA, Annual Energy Outlook 2022.



change in the last decade to the country's overall generation mix as natural gas and renewable energy generation increased while coal-fired generation decreased.

While the current and near-term expectations for natural gas prices are higher than recent historical levels, the price of natural gas is expected to decline to lower levels in the medium and long term.<sup>3</sup> In addition, the existing fleet of coal-fired power plants continues to age. With a continued (but reduced) tax credit and declining capital costs, solar capacity is projected to grow through 2050, while tax credits that phase out for plants entering service through 2023 provide incentives for new wind capacity in the near-term.<sup>5</sup> Some power generators have announced that they expect to continue to change their generation mix away from coal-fired generation and toward natural-gas fired generation, renewables, and more deployment of energy efficiency measures.<sup>6</sup> All these factors, in total, have resulted in declining power sector emissions in recent years, a trend that is expected to continue.

### Acid Rain Program

Title IV of the 1990 Clean Air Act Amendments established the ARP to address acid deposition nationwide by reducing annual SO<sub>2</sub> and NO<sub>x</sub> emissions from fossil fuel-fired power plants. In contrast to traditional command and control regulatory methods that establish specific emissions limitations, the ARP SO<sub>2</sub> program introduced a landmark emissions trading system that harnessed the economic incentives of the market to reduce pollution. This market-based emissions trading program was implemented in two phases. Phase I began in 1995 and affected the most polluting units, largely coal-fired, in 21 eastern and midwestern states. Phase II began in 2000 and expanded the program to include other units fired by coal, oil, and gas in the contiguous U.S. Under Phase II, Congress also tightened the annual SO<sub>2</sub> emissions cap with a permanent annual cap set at 8.95 million allowances starting in 2010. The NO<sub>x</sub> program has a similar results-oriented approach and ensures program integrity through measurement and reporting. However, it does not cap NO<sub>x</sub> emissions, nor does it utilize an emissions trading system. Instead, the ARP NO<sub>x</sub> program provisions apply boiler-specific NO<sub>x</sub> emission limits – or rates – in pounds per million British thermal units (lb/mmBtu) on certain coal-fired boilers. There is a degree of flexibility, however. Units under common control, which are owned or operated by the same company, can comply using emission rate averaging plans, subject to requirements ensuring that the total mass emissions from the units in an averaging plan do not exceed the total mass emissions the units would have emitted at their individual emission rate limits.

### NO<sub>x</sub> Budget Trading Program

The NBP was a market-based emissions trading program created to reduce NO<sub>x</sub> emissions from power plants and other large stationary combustion sources during the summer ozone season to address regional air pollution transport that contributes to the formation of ozone in the eastern United States. The program, which operated during the ozone seasons from 2003 to 2008, was a central component of the NO<sub>x</sub> State Implementation Plan (SIP) Call, promulgated in 1998, to help states attain the 1979 ozone NAAQS. All 21 jurisdictions (20 states plus Washington, D.C.) covered by the NO<sub>x</sub> SIP Call opted to

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<sup>3</sup> EIA, Annual Energy Outlook 2022.

<sup>5</sup> EIA, Annual Energy Outlook 2021.

<sup>6</sup> EIA, "Corporate Goal Case Using Annual Energy Outlook 2021".



participate in the NBP. In 2009, the CAIR's NO<sub>x</sub> ozone season program began, effectively replacing the NBP to continue achieving ozone season NO<sub>x</sub> emission reductions from the power sector.

### Clean Air Interstate Rule

CAIR required 25 eastern jurisdictions (24 states plus Washington, D.C.) to limit annual power sector emissions of SO<sub>2</sub> and NO<sub>x</sub> to address regional interstate transport of air pollution that contributes to the formation of fine particulates. It also required 26 jurisdictions (25 states plus Washington, D.C.) to limit power sector ozone season NO<sub>x</sub> emissions to address regional interstate transport of air pollution that contributes to the formation of ozone during the ozone season. CAIR used three separate market-based emissions trading programs to achieve emission reductions and to help states meet the 1997 ozone and fine particle NAAQS.

EPA issued CAIR on May 12, 2005, and the CAIR federal implementation plans (FIPs) on April 26, 2006. In 2008, the U.S. Court of Appeals for the DC Circuit remanded CAIR to the Agency, leaving the existing CAIR programs in place while directing EPA to replace them as rapidly as possible with a new rule consistent with the Clean Air Act. The CAIR NO<sub>x</sub> ozone season and NO<sub>x</sub> annual programs began in 2009, while the CAIR SO<sub>2</sub> program began in 2010. As discussed below, CAIR was replaced by CSAPR in 2015.

### Cross-State Air Pollution Rule

EPA issued CSAPR in July 2011, requiring 28 states in the eastern half of the U.S. to significantly improve air quality by reducing power plant emissions that travel across state lines and contribute to fine particle and summertime ozone pollution in downwind states. CSAPR required 23 states to reduce annual SO<sub>2</sub> and NO<sub>x</sub> emissions to help downwind areas attain the 2006 24-hour PM<sub>2.5</sub> NAAQS and/or the 1997 annual PM<sub>2.5</sub> NAAQS. CSAPR also required 25 states to reduce ozone season NO<sub>x</sub> emissions to help downwind areas attain the 1997 ozone NAAQS. CSAPR divides the states required to reduce SO<sub>2</sub> emissions into two groups (Group 1 and Group 2). Both groups were required to reduce their SO<sub>2</sub> emissions in Phase I. All Group 1 states, as well as some Group 2 states, were required to make additional reductions in SO<sub>2</sub> emissions in Phase II in order to eliminate their significant contribution to air quality problems in downwind areas.

CSAPR was scheduled to replace CAIR starting on January 1, 2012. However, the timing of CSAPR's implementation was affected by D.C. Circuit actions that stayed and then vacated CSAPR before implementation. On April 29, 2014, the U.S. Supreme Court reversed the D.C. Circuit's vacatur, and on October 23, 2014, the D.C. Circuit granted EPA's motion to lift the stay and shift the CSAPR compliance deadlines by three years. Accordingly, CSAPR Phase I implementation began on January 1, 2015, replacing CAIR, and CSAPR Phase II began January 1, 2017.

### Cross-State Air Pollution Rule Update

On September 7, 2016, EPA finalized an update to the CSAPR ozone season program by issuing the CSAPR Update. This rule addressed summertime ozone pollution in the eastern U.S. that crosses state lines in order to help downwind states and communities meet and maintain the 2008 ozone NAAQS. In May 2017, the CSAPR Update began further reducing ozone season NO<sub>x</sub> emissions from power plants in 22 states in the eastern U.S. When issuing the CSAPR Update, EPA found that while the rule would result in meaningful, near-term reductions in ozone pollution that crosses state lines, the rule might not be



sufficient to fully address all covered states' good neighbor obligations<sup>7</sup> with respect to the 2008 ozone NAAQS. In December 2018, based on additional analysis conducted after issuance of the rule, EPA published a determination that the emission reductions required by the CSAPR Update in fact would fully address all covered states' good neighbor obligations with respect to this NAAQS.

In September 2019, the D.C. Circuit upheld the CSAPR Update in most respects but remanded the rule to EPA to address the court's holding that the rule unlawfully allowed upwind states' significant contribution to downwind air quality problems to continue beyond downwind states' deadlines for attaining the NAAQS. Relatedly, in October 2019, the court vacated EPA's December 2018 determination that the CSAPR Update fully addressed covered states' good neighbor obligations with respect to the 2008 ozone NAAQS.

### Revised Cross-State Air Pollution Rule Update

On March 15, 2021, EPA finalized the Revised CSAPR Update to resolve 21 states' outstanding interstate transport obligations for the 2008 ozone NAAQS. Based on EPA's analysis, the Agency determined that additional emission reductions relative to the CSAPR Update were necessary for 12 of the 21 states. These reductions were based on optimization of existing, already-installed controls beginning in the 2021 ozone season, and installation or upgrade of state-of-the-art NO<sub>x</sub> combustion controls beginning in the 2022 ozone season. This rulemaking also adjusted these 12 states' ozone season emission budgets through 2024 to incentivize the continued use of these control technologies. The rule became effective on June 29, 2021.

### Mercury and Air Toxics Standards

On December 16, 2011, the EPA announced final standards to reduce emissions of toxic air pollutants from new and existing coal- and oil-fired power plants in all 50 states and U.S. territories. MATS established technology-based emission rate standards that reflect the level of hazardous air pollutant (HAP) emissions that had been achieved by the best-performing sources. These HAPs include mercury (Hg), non-mercury metals (such as arsenic (As), chromium (Cr), and nickel (Ni)), and acid gases, including hydrochloric acid (HCl) and hydrofluoric acid (HF). EPA provided the maximum 3-year compliance period, so sources were generally required to comply no later than April 16, 2015. Some sources obtained a one-year extension from their state permitting authority, as allowed under the CAA, and thus were required to comply with the final rule by April 16, 2016.

### More Information

- Acid Rain Program (ARP) <https://www.epa.gov/acidrain/acid-rain-program>
- Interstate Air Pollution Transport <https://www.epa.gov/interstate-air-pollution-transport>
- Cross-State Air Pollution Rule (CSAPR) <https://www.epa.gov/csapr>
- Cross-State Air Pollution Rule Update (CSAPR Update) <https://www.epa.gov/airmarkets/final-cross-state-air-pollution-rule-update>

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<sup>7</sup> "Good neighbor" obligations refer to provisions in the Clean Air Act that require upwind states to reduce the emissions that affect downwind states' ability to attain or maintain NAAQS.

## 2021 Power Sector Programs – Progress Report

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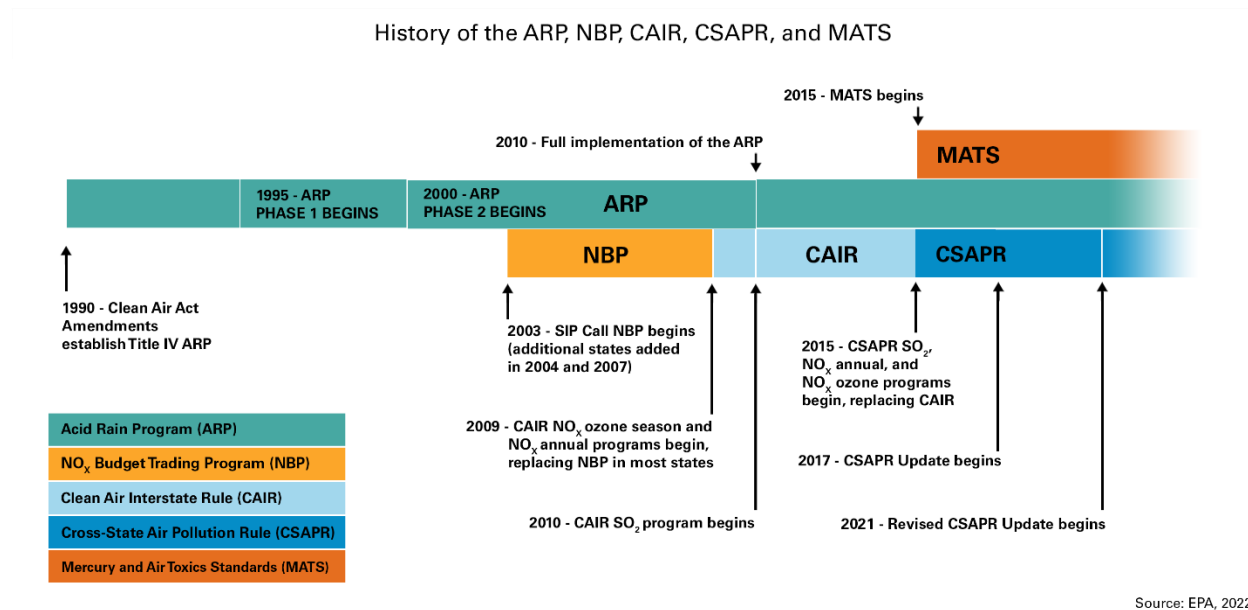
[https://www3.epa.gov/airmarkets/progress/reports/program\\_basics.html](https://www3.epa.gov/airmarkets/progress/reports/program_basics.html)



- Revised CSAPR Update <https://www.epa.gov/csapr/reviced-cross-state-air-pollution-rule-update>
- Clean Air Interstate Rule (CAIR) <https://archive.epa.gov/airmarkets/programs/cair/web/html/index.html>
- NO<sub>x</sub> Budget Trading Program (NBP) / NO<sub>x</sub> SIP Call <https://www.epa.gov/airmarkets/nox-budget-trading-program>
- National Ambient Air Quality Standards (NAAQS) <https://www.epa.gov/criteria-air-pollutants>
- EPA's Clean Air Market Programs <https://www.epa.gov/airmarkets/programs>
- Emissions Trading <https://www.epa.gov/emissions-trading-resources>
- Mercury and Air Toxics Standards <https://www.epa.gov/stationary-sources-air-pollution/mercury-and-air-toxics-standards>
- EIA Annual Energy Outlook <https://www.eia.gov/outlooks/aeo>
- Corporate Goal Case Using Annual Energy Outlook 2021 [https://www.eia.gov/outlooks/aeo/corporate\\_goal/](https://www.eia.gov/outlooks/aeo/corporate_goal/)



## Figures

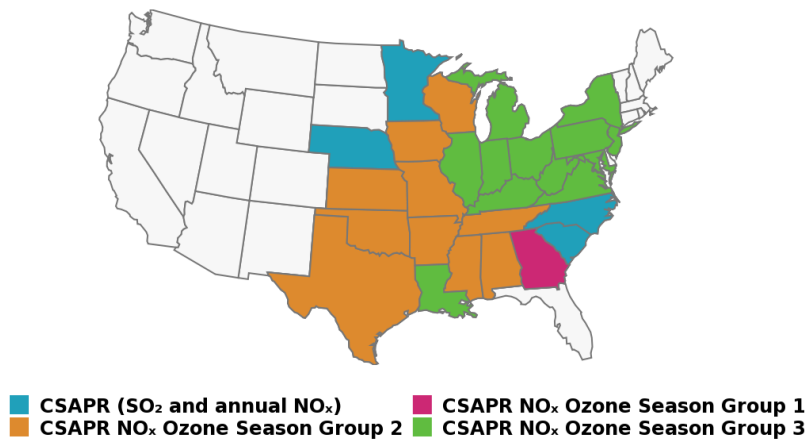


Source: EPA, 2022

Figure 1. History of the ARP, NBP, CAIR, CSAPR, and MATS



### Map of CSAPR Implementation, 2021



Notes:

- The ARP covers sources in all of the lower 48 states.
- To more clearly see the states included in the "CSAPR (SO<sub>2</sub> and annual NO<sub>x</sub>)" program, use the interactive features of the figure: click on the boxes in the legend to turn off the pink, orange, and green categories (labeled "CSAPR NO<sub>x</sub> Ozone Season").

Source: EPA, 2022

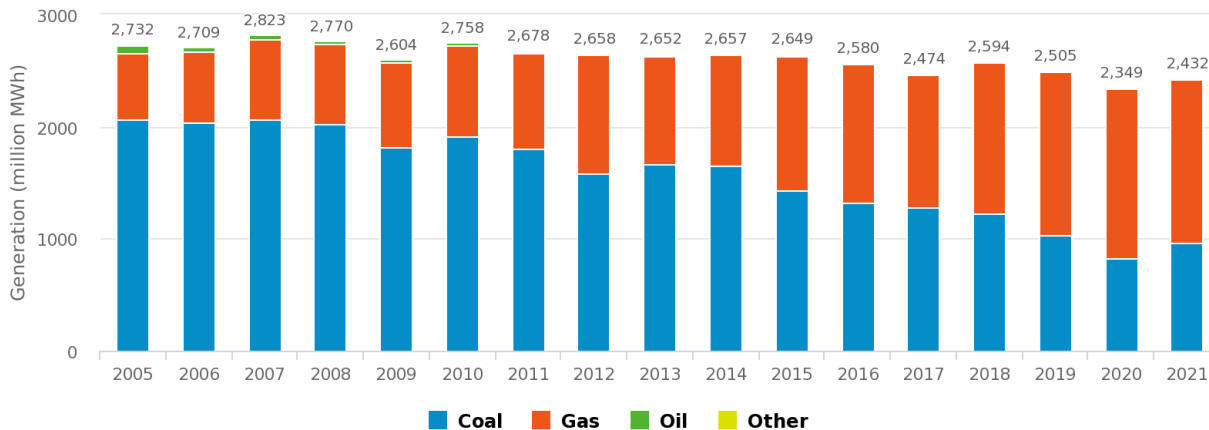
**Figure 2. Map of CSAPR Implementation for 2021**

Notes:

- The ARP cover sources in all of the lower 48 states.
- To more clearly see the states included in the "CSAPR (SO<sub>2</sub> and annual NO<sub>x</sub>)" program, use the interactive features of the figure: click on the boxes in the legend to turn off the pink, orange, and green categories (labeled "CSAPR NO<sub>x</sub> Ozone Season").



### Electricity Generation from ARP- and CSAPR-Affected Power Plants, 2005–2021



Notes:

• There is a small amount of generation from “Oil” or “Other” fuels. The data for these fuels is not easily visible on the full chart. To more clearly see the generation data for these fuels, use the interactive features of the figure: click on the boxes in the legend to turn off the blue and orange categories of fuels (labeled “Coal” and “Gas”) and turn on the green and yellow categories of fuels (labeled “Oil” and “Other”).

Source: EPA, 2022

**Figure 3. Electricity Generation from ARP- and CSAPR-Affected Power Plants, 2005–2021**

Notes:

• There is a small amount of generation from “Oil” or “Other” fuels. The data for these fuels is not easily visible on the full chart. To more clearly see the generation data for these fuels, use the interactive features of the figure: click on the boxes in the legend to turn off the blue and orange categories of fuels (labeled “Coal” and “Gas”) and turn on the green and yellow categories of fuels (labeled “Oil” and “Other”).





## Chapter 2: Regulated Emissions Sources

The Acid Rain Program (ARP) and the Cross-State Air Pollution Rule's (CSAPR)<sup>1</sup> sulfur dioxide (SO<sub>2</sub>) and nitrogen oxides (NO<sub>x</sub>) emission reduction programs apply to large power plants that burn fossil fuels to generate electricity for sale. The Mercury and Air Toxics Standards (MATS) only cover large power plants that burn coal or oil to generate electricity for sale and excludes gas-fired units, resulting in fewer units in MATS than in the ARP and CSAPR.

### Highlights

#### Acid Rain Program (ARP)

- In 2021, the ARP SO<sub>2</sub> requirements applied to 3,243 fossil fuel-fired units at 1,150 power plants across the country; 493 units at 227 power plants were subject to the ARP NO<sub>x</sub> program.

#### Cross-State Air Pollution Rule (CSAPR)

- In 2021, there were 2,125 regulated emissions sources at 665 power plants in the CSAPR SO<sub>2</sub> programs. Of those, 1,713 (81 percent) were also covered by the ARP.
- In 2021, there were 2,125 regulated emissions sources at 665 power plants in the CSAPR NO<sub>x</sub> annual program and 2,499 regulated emissions sources at 799 power plants in the CSAPR NO<sub>x</sub> ozone season programs. Of those, 1,713 (81 percent) and 2,079 (83 percent), respectively, were also covered by the ARP.

#### Mercury and Air Toxics (MATS)

- The Mercury and Air Toxics Standards (MATS) set limits on the emissions of hazardous air pollutants from coal- and oil-fired electric utility steam generating units in all 50 states and U.S. territories. MATS was issued under section 112 of the Clean Air Act. EPA is including a summary of the mercury data submitted by affected sources in this report.
- In 2021, 406 units at 186 power plants reported hourly mercury emissions to EPA under MATS.

### Background Information

In general, the ARP and CSAPR programs (CSAPR, CSAPR Update, and the Revised CSAPR Update) apply to large electricity generating units – boilers, turbines, and combined cycle units – that burn fossil fuel, serve generators with nameplate capacity greater than 25 megawatts, and produce electricity for sale. MATS applies only to coal- and oil-fired steam generating units (i.e., utility boilers). MATS does not apply to combustion turbines, combined cycle units, or to natural gas-fired utility boilers. The power plants affected by these programs include 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 only on peak demand days. The ARP NO<sub>x</sub> program applies to a subset of these units that are older and historically coal-fired.

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<sup>1</sup> CSAPR refers to the CSAPR, the CSAPR Update, and the Revised CSAPR Update programs.

## 2021 Power Sector Programs – Progress Report

[https://www3.epa.gov/airmarkets/progress/reports/regulated\\_emissions\\_sources.html](https://www3.epa.gov/airmarkets/progress/reports/regulated_emissions_sources.html)

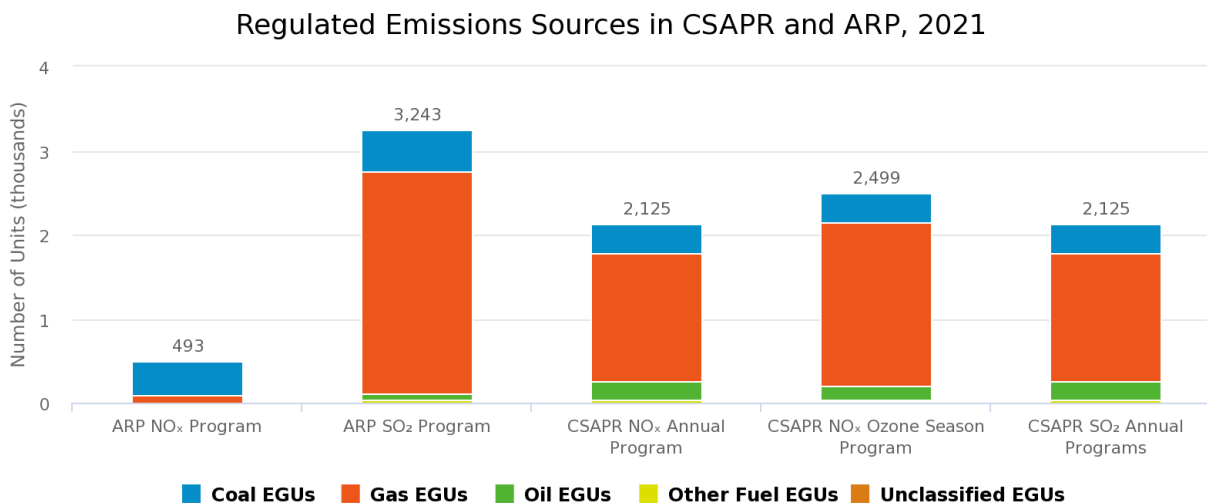


### More Information

- Acid Rain Program (ARP) <https://www.epa.gov/acidrain/acid-rain-program>
- Cross-State Air Pollution Rule (CSAPR) <https://www.epa.gov/csapr>
- Mercury and Air Toxics Standards (MATS) <https://www.epa.gov/stationary-sources-air-pollution/mercury-and-air-toxics-standards>



## Figures



Notes:

- "Unclassified" units have not submitted a fuel type in their monitoring plan and did not report emissions.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).

Source: EPA, 2022

**Figure 1. Regulated Emissions Sources in CSAPR and ARP, 2021**

Notes:

- "Unclassified" units have not submitted a fuel type in their monitoring plan and did not report emissions.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).



Regulated Emissions Sources in CSAPR and ARP, 2021

Fuel	ARP NO <sub>x</sub>	ARP SO <sub>2</sub>	CSAPR Annual NO <sub>x</sub>	CSAPR Ozone Season NO <sub>x</sub>	CSAPR Annual SO <sub>2</sub>
Coal EGUs	410	487	351	352	351
Gas EGUs	81	2,641	1,525	1,948	1,525
Oil EGUs	0	83	216	164	216
Other Fuel EGUs	2	27	33	24	33
Unclassified EGUs	0	5	0	11	0
<b>Total Units</b>	<b>493</b>	<b>3,243</b>	<b>2,125</b>	<b>2,499</b>	<b>2,125</b>

Notes:

- "Unclassified" units have not submitted a fuel type in their monitoring plan and did not report emissions.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).

Source: EPA, 2022  
Last updated: 04/2022

**Figure 2. Regulated Emissions Sources in CSAPR and ARP, 2021**

Notes:

- "Unclassified" units have not submitted a fuel type in their monitoring plan and did not report emissions.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).



## Chapter 3: Emission Reductions

The Acid Rain Program (ARP) and Cross-State Air Pollution Rule (CSAPR) programs<sup>1</sup> significantly reduced sulfur dioxide (SO<sub>2</sub>), annual nitrogen oxides (NO<sub>x</sub>), and ozone season NO<sub>x</sub> emissions from power plants. The Mercury and Air Toxics Standards (MATS) set limits on the emissions of hazardous air pollutants from coal and oil burning power plants and have led to reductions in those emissions since 2010. This section covers changes in emissions at power plants affected by CSAPR, ARP, and MATS between 2021 and previous years.

### Sulfur Dioxide (SO<sub>2</sub>)

#### Highlights

##### Overall Results

- Under the ARP, CAIR, and CSAPR, power plants have significantly lowered SO<sub>2</sub> emissions while electricity generation from power plants in these programs has remained relatively stable since 2000.
- These emission reductions are a result of an overall increase in the environmental effectiveness at affected sources as electric generators installed controls, switched to lower emitting fuels, or otherwise reduced their SO<sub>2</sub> emissions. These trends are discussed further in Chapter 1.

##### SO<sub>2</sub> Emission Trends

- **ARP:** Units in the ARP emitted 936,000 tons of SO<sub>2</sub> in 2021, well below the ARP's statutory annual cap of 8.95 million tons. The ARP sources reduced emissions by 14.8 million tons (94 percent) from 1990 levels and 16.3 million tons (95 percent) from 1980 levels.
- **CSAPR and ARP:** In 2021, the seventh year of operation of the CSAPR SO<sub>2</sub> program, sources in both the CSAPR SO<sub>2</sub> annual programs and the ARP together reduced SO<sub>2</sub> emissions by 14.8 million tons (94 percent) from 1990 levels (before implementation of the ARP), 10.3 million tons (92 percent) from 2000 levels (ARP Phase II), and 9.3 million tons (91 percent) from 2005 levels (before implementation of the CAIR and the CSAPR). All ARP and CSAPR sources together emitted a total of 942,000 tons of SO<sub>2</sub> in 2021.
- **CSAPR:** Annual SO<sub>2</sub> emissions from sources in the CSAPR SO<sub>2</sub> programs fell from 7.7 million tons in 2005 to 592,000 tons in 2021 (93 percent). In 2021, SO<sub>2</sub> emissions were about 1.4 million tons below the regional CSAPR emission budgets (0.85 million in Group 1 and 0.52 million in Group 2); the CSAPR SO<sub>2</sub> annual programs' 2021 regional budgets are 1,372,631 and 597,579 tons for Group 1 and Group 2, respectively.

##### SO<sub>2</sub> State-by-State Emissions

- **CSAPR and ARP:** From 1990 to 2021, annual SO<sub>2</sub> emissions from sources in the ARP and the CSAPR SO<sub>2</sub> program dropped in 46 states plus Washington, D.C. by a total of 14.8 million tons. In

<sup>1</sup> CSAPR refers to the CSAPR, the CSAPR Update, and the Revised CSAPR Update programs.



contrast, annual SO<sub>2</sub> emissions increased in two states (Idaho and Vermont) by a combined total of 13 tons from 1990 to 2021.

- **CSAPR:** All 22 states (16 states in Group 1 and 6 states in Group 2) had emissions below their CSAPR allowance budgets, collectively by 1.4 million tons.

### SO<sub>2</sub> Emission Rates

- The average SO<sub>2</sub> emission rate for units in the ARP or CSAPR SO<sub>2</sub> program fell to 0.09 pounds per million British thermal units (lb/mmBtu). This indicates an 88 percent reduction from 2005 rates, with most reductions coming from coal-fired units.
- Emissions have decreased dramatically since 2005, due in large part to greater use of control technology on coal-fired units and increased generation at natural gas-fired units that emit very little SO<sub>2</sub> emissions.

### Background Information

SO<sub>2</sub> is a highly reactive gas that is generated primarily from coal-fired power plants. In addition to contributing to the formation of acid rain and fine particle (PM<sub>2.5</sub>) pollution, SO<sub>2</sub> emissions are linked with a number of [adverse effects to human health](#) and [ecosystems](#).

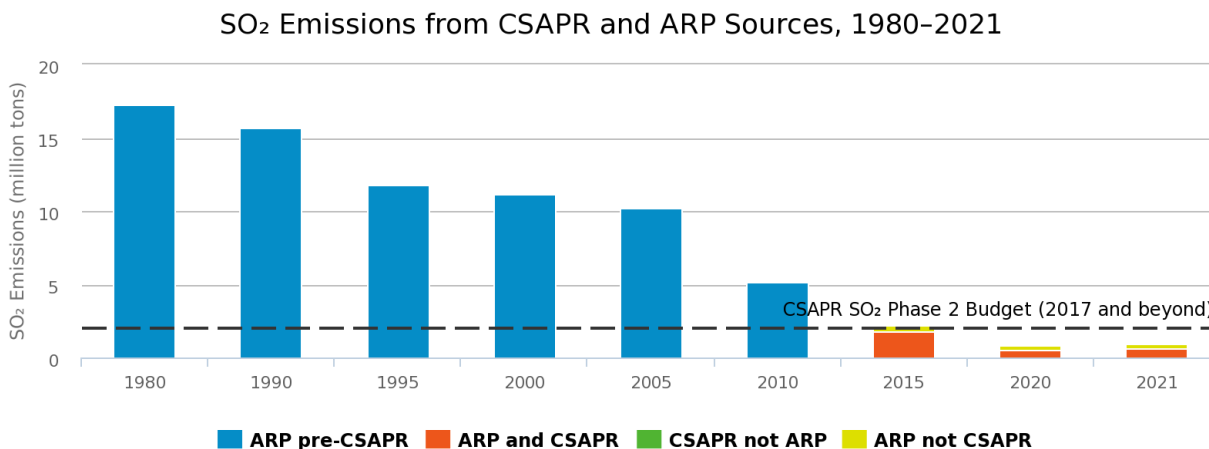
The states with the highest emitting sources in 1990 have generally seen the greatest SO<sub>2</sub> emission reductions under the ARP, and this trend continued under CAIR and CSAPR. Most of these states are in the Ohio River Valley and are upwind of the areas the ARP and CSAPR were designed to protect. Reductions under these programs have provided important environmental and health benefits over a large region.

### More Information

- Power Plant Emission Trends <https://www.epa.gov/airmarkets/power-plant-emission-trends>
- Power Sector Emissions, Operations, and Environmental Data <https://www.epa.gov/airmarkets/data-resources>
- Acid Rain Program (ARP) <https://www.epa.gov/acidrain/acid-rain-program>
- Cross-State Air Pollution Rule (CSAPR) <https://www.epa.gov/csapr>
- Sulfur Dioxide (SO<sub>2</sub>) Pollution <https://www.epa.gov/so2-pollution>
- Particulate Matter (PM) Pollution <https://www.epa.gov/pm-pollution>
- Power Profiler <https://www.epa.gov/energy/power-profiler>



## Figures



Notes:

- SO<sub>2</sub> values are shown as millions of tons.
- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only SO<sub>2</sub> program units are not included in the SO<sub>2</sub> data prior to 2015.
- There are a small number of sources in CSAPR but not in the ARP. Emissions from these sources comprise about 1 percent of total emissions and are not easily visible on the full chart.

Source: EPA, 2022

**Figure 1. SO<sub>2</sub> Emissions from CSAPR and ARP Sources, 1980–2021**

Notes:

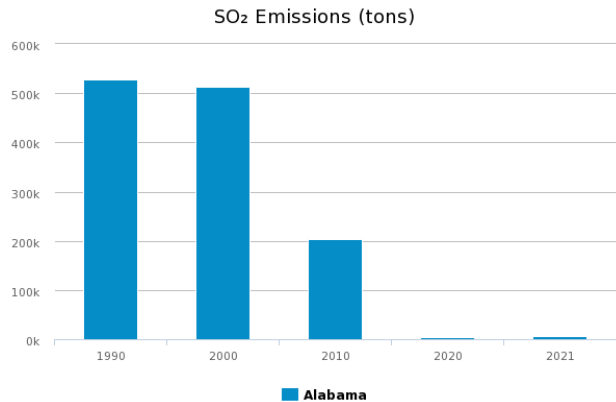
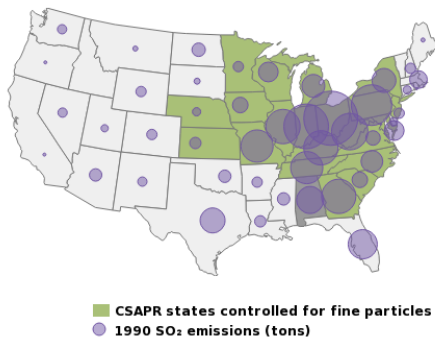
- SO<sub>2</sub> values are shown as millions of tons.
- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only SO<sub>2</sub> program units are not included in the SO<sub>2</sub> data prior to 2015.
- There are a small number of sources in CSAPR but not in the ARP. Emissions from these sources comprise about 1 percent of total emissions and are not easily visible on the full chart.

## 2021 Power Sector Programs – Progress Report

[https://www3.epa.gov/airmarkets/progress/reports/emissions\\_reductions.html](https://www3.epa.gov/airmarkets/progress/reports/emissions_reductions.html)



State-by-State SO<sub>2</sub> Emissions from CSAPR and ARP Sources, 1990–2021



Notes:

• The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only SO<sub>2</sub> program units are not included in the SO<sub>2</sub> data prior to 2015.

Source: EPA, 2022

**Figure 2. State-by-State SO<sub>2</sub> Emissions from CSAPR and ARP Sources, 1990–2021**

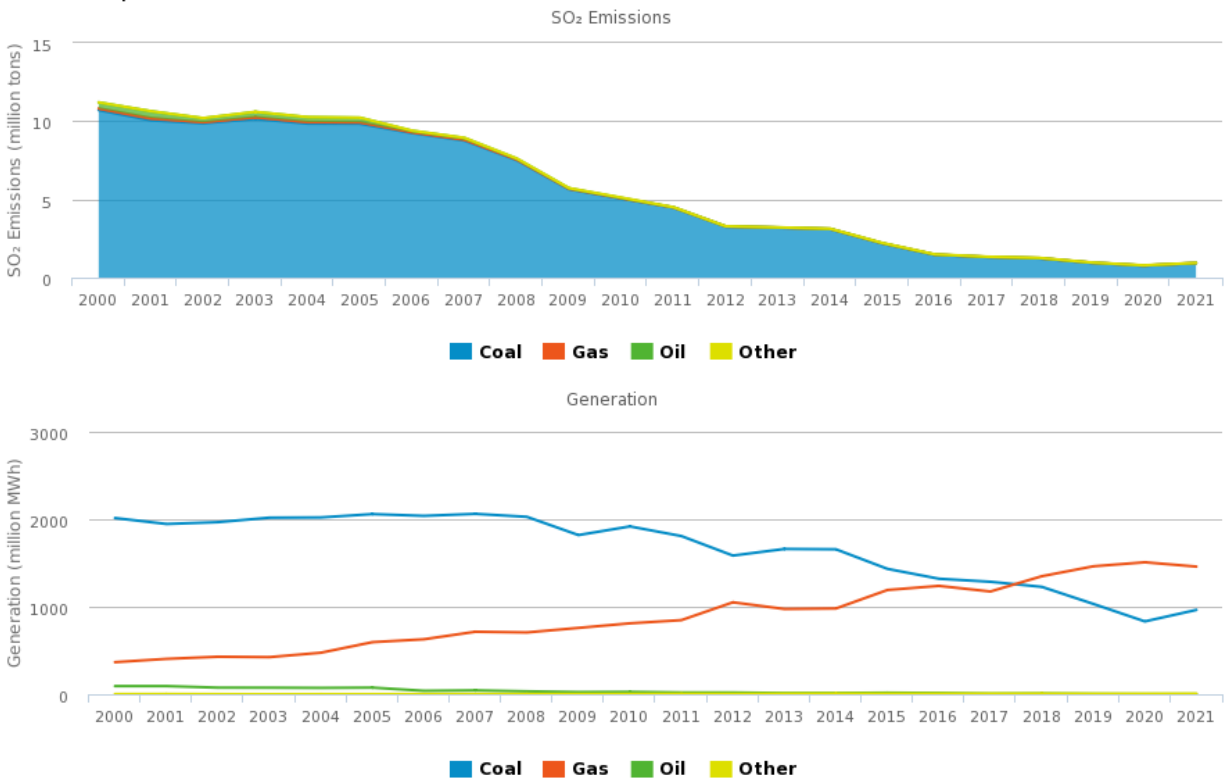
Notes:

• The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only SO<sub>2</sub> program units are not included in the SO<sub>2</sub> data prior to 2015.





Comparison of SO<sub>2</sub> Emissions and Generation for CSAPR and ARP Sources, 2000–2021



Notes:

- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only SO<sub>2</sub> program units are not included in the SO<sub>2</sub> data prior to 2015.
- Fuel type represents primary fuel type; units might combust more than one fuel.

Source: EPA, 2022

**Figure 3. Comparison of SO<sub>2</sub> Emissions and Generation for CSAPR and ARP Sources, 2000–2021**

Notes:

- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only SO<sub>2</sub> program units are not included in the SO<sub>2</sub> data prior to 2015.
- Fuel type represents primary fuel type; units might combust more than one fuel.



CSAPR and ARP SO<sub>2</sub> Emissions Trends, 2021

Primary Fuel	SO <sub>2</sub> Emissions (thousand tons)					SO <sub>2</sub> Rate (lb/mmBtu)				
	2000	2005	2010	2020	2021	2000	2005	2010	2020	2021
Coal	10,708	9,835	5,052	788	927	1.04	0.95	0.53	0.18	0.19
Gas	108	91	19	5	8	0.06	0.03	0.01	0.00	0.00
Oil	384	292	28	1	1	0.73	0.70	0.19	0.04	0.06
Other	1	4	22	11	7	0.23	0.27	0.57	0.17	0.10
<b>Total / Average</b>	<b>11,201</b>	<b>10,222</b>	<b>5,120</b>	<b>788</b>	<b>942</b>	<b>0.88</b>	<b>0.75</b>	<b>0.39</b>	<b>0.08</b>	<b>0.09</b>

Notes:

- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only SO<sub>2</sub> program units are not included in the SO<sub>2</sub> emissions data prior to 2015.
- 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.
- The emission rate reflects the emissions (pounds) per unit of heat input (mmBtu) for each fuel category. The total SO<sub>2</sub> emission rate in each column of the table is not cumulative and does not equal the arithmetic mean of the four fuel-specific rates. The total for each year indicates the average rate across all units in the program because each unit influences the annual emission rate in proportion to its heat input, and heat input is unevenly distributed across the fuel categories.

Source: EPA, 2022

**Figure 4. CSAPR and ARP SO<sub>2</sub> Emissions Trends, 2000-2021**

Notes:

- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only SO<sub>2</sub> program units are not included in the SO<sub>2</sub> emissions data prior to 2015.
- 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.
- The emission rate reflects the emissions (pounds) per unit of heat input (mmBtu) for each fuel category. The total SO<sub>2</sub> emission rate in each column of the table is not cumulative and does not equal the arithmetic mean of the four fuel-specific rates. The total for each year indicates the average rate across all units in the program because each unit influences the annual emission rate in proportion to its heat input, and heat input is unevenly distributed across the fuel categories.



## Annual Nitrogen Oxides

### Highlights

#### Overall Results

- Annual NO<sub>x</sub> emissions have declined dramatically under the ARP, CAIR, and CSAPR programs, with most reductions coming from coal-fired units. These reductions have occurred while electricity generation has remained relatively stable since 2000.
- These emission reductions are a result of an overall increase in the environmental efficiency at affected sources as power generators installed controls, ran their controls year-round, switched to lower emitting fuels, or otherwise reduced their NO<sub>x</sub> emissions. These trends are discussed further in Chapter 1.
- Other programs – such as regional and state NO<sub>x</sub> emission control programs – also contributed significantly to the annual NO<sub>x</sub> emission reductions achieved by sources in 2021.

#### Annual NO<sub>x</sub> Emissions Trends

- **ARP:** Units in the ARP NO<sub>x</sub> program emitted 763,000 tons of NO<sub>x</sub> emissions in 2021. Sources reduced emissions by 7.3 million tons from the projected level in 2000 without the ARP, over three times the program's NO<sub>x</sub> emission reduction objective.
- **CSAPR and ARP:** In 2021, the seventh year of operation of the CSAPR NO<sub>x</sub> annual program, sources in both the CSAPR NO<sub>x</sub> annual program and the ARP together emitted 779,000 tons, a reduction of 5.6 million tons (88 percent reduction) from 1990 levels, 4.4 million tons (85 percent reduction) from 2000, and 2.9 million tons (79 percent reduction) from 2005 levels.
- **CSAPR:** Emissions from the CSAPR NO<sub>x</sub> annual program sources were 440,000 tons in 2021. This is about 1.7 million tons (80 percent) lower than in 2005 and 629,000 tons (59 percent) below the CSAPR NO<sub>x</sub> annual program's 2021 regional budget of 1,069,256 tons.

#### Annual NO<sub>x</sub> State-by-State Emissions

- **CSAPR and ARP:** From 1990 to 2021, annual NO<sub>x</sub> emissions in the ARP and the CSAPR NO<sub>x</sub> program dropped in 47 states plus Washington, D.C. by a total of approximately 5.6 million tons. In contrast, annual emissions increased in one state (Idaho) by 428 tons from 1990 to 2021.
- **CSAPR:** 21 of 22 states had emissions below their CSAPR 2021 allowance budgets, collectively by 632,000 tons. One state (Missouri) exceeded its 2021 state level budget by 2,623 tons. For more information about Program Compliance, see the [Program Compliance](#) chapter.

#### Annual NO<sub>x</sub> Emission Rates

- In 2021, the ARP and CSAPR average annual NO<sub>x</sub> emission rate was 0.07 lb/mmBtu, a 73 percent reduction from 2005.
- Emissions have decreased dramatically since 2005, due in large part to greater use of control technology, primarily on coal-fired units, and increased generation at natural gas-fired units that emit less NO<sub>x</sub> emissions per unit of electricity than coal-fired units.



## Background Information

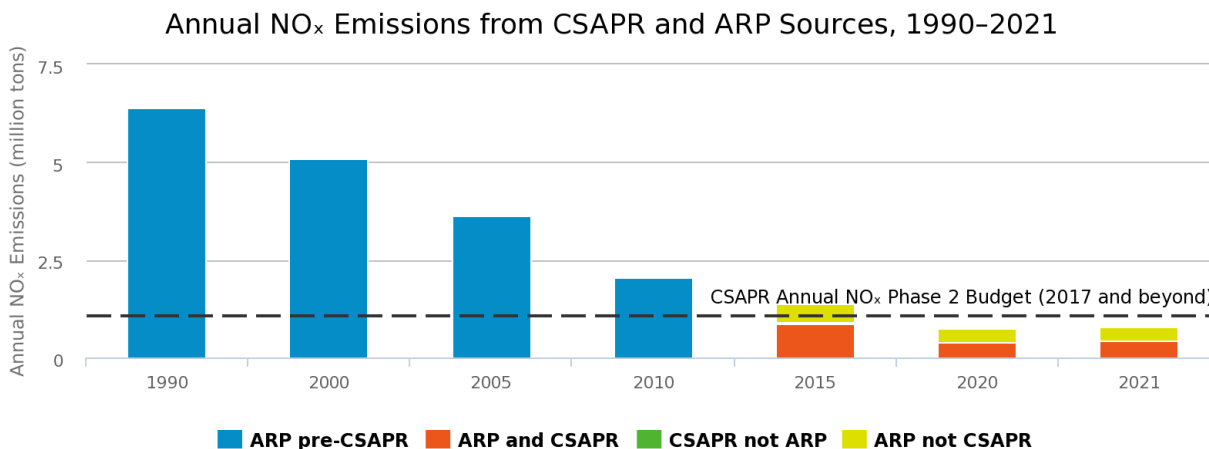
Nitrogen oxides (NO<sub>x</sub>) are made up of a group of highly reactive gases that are emitted from power plants and motor vehicles, as well as other sources. NO<sub>x</sub> emissions contribute to the formation of ground-level ozone and fine particle pollution, which cause a variety of [adverse health effects](#).

## More Information

- Power Plant Emission Trends <https://www.epa.gov/airmarkets/power-plant-emission-trends>
- Power Sector Emissions, Operations, and Environmental Data <https://www.epa.gov/airmarkets/data-resources>
- Acid Rain Program (ARP) <https://www.epa.gov/acidrain/acid-rain-program>
- Cross-State Air Pollution Rule (CSAPR) <https://www.epa.gov/csapr>
- Nitrogen Oxides (NO<sub>x</sub>) Pollution <https://www.epa.gov/no2-pollution>
- Particulate Matter (PM) Pollution <https://www.epa.gov/pm-pollution>
- Power Profiler <https://www.epa.gov/energy/power-profiler>



## Figures



Notes:

- NO<sub>x</sub> values are shown as millions of tons.
- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only NO<sub>x</sub> program units are not included in the NO<sub>x</sub> data prior to 2015.
- There are a small number of sources in CSAPR but not in the ARP. Emissions from these sources comprise about 1 percent of total emissions and are not easily visible on the full chart.

Source: EPA, 2022

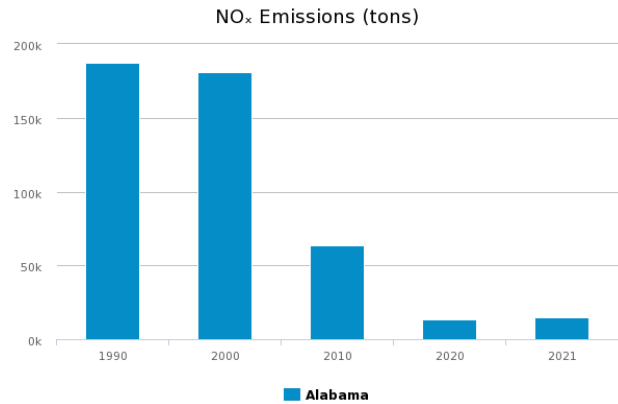
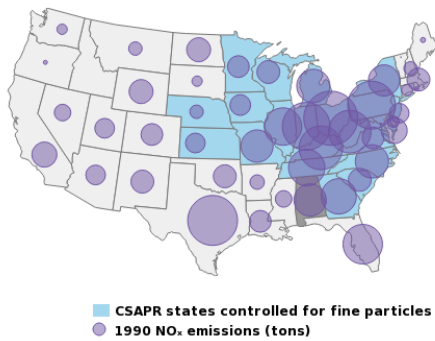
**Figure 1. Annual NO<sub>x</sub> Emissions from CSAPR and ARP Sources, 1990–2021**

Notes:

- NO<sub>x</sub> values are shown as millions of tons.
- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only NO<sub>x</sub> program units are not included in the NO<sub>x</sub> data prior to 2015.
- There are a small number of sources in CSAPR but not in the ARP. Emissions from these sources comprise about 1 percent of total emissions and are not easily visible on the full chart.



State-by-State Annual NO<sub>x</sub> Emissions from CSAPR and ARP Sources, 1990–2021



Notes:

• The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only NO<sub>x</sub> program units are not included in the NO<sub>x</sub> data prior to 2015.

Source: EPA, 2022

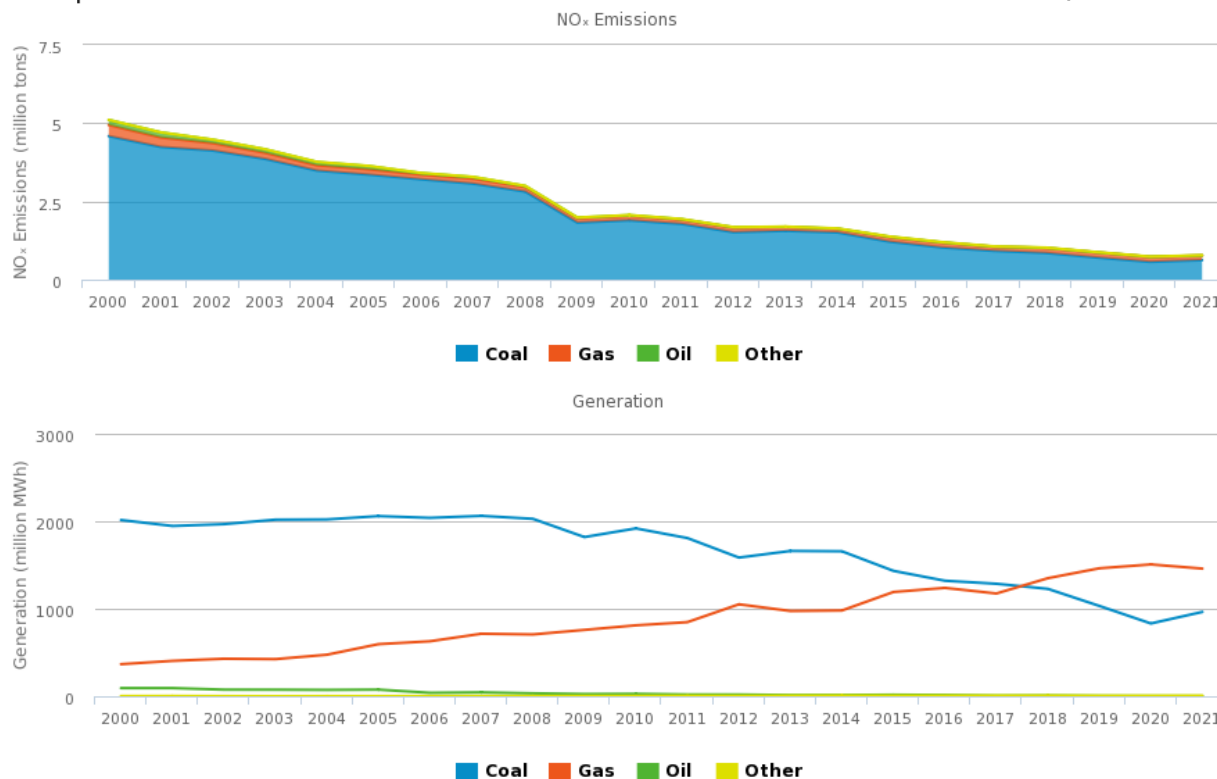
**Figure 2. State-by-State Annual NO<sub>x</sub> Emissions from CSAPR and ARP Sources, 1990–2021**

Notes:

• The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only NO<sub>x</sub> program units are not included in the NO<sub>x</sub> data prior to 2015.



Comparison of Annual NO<sub>x</sub> Emissions and Generation for CSAPR and ARP Sources, 2000–2021



Notes:

- The data shown here for the annual programs reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR NO<sub>x</sub> annual program units are not included in the annual NO<sub>x</sub> emissions data prior to 2015.
- Fuel type represents primary fuel type; units might combust more than one fuel.

Source: EPA, 2022

**Figure 3. Comparison of Annual NO<sub>x</sub> Emissions and Generation for CSAPR and ARP Sources, 2000–2021**

Notes:

- The data shown here for the annual programs reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR NO<sub>x</sub> annual program units are not included in the annual NO<sub>x</sub> emissions data prior to 2015.
- Fuel type represents primary fuel type; units might combust more than one fuel.



CSAPR and ARP Annual NO<sub>x</sub> Emissions Trends, 2021

Primary Fuel	NO <sub>x</sub> Emissions (thousand tons)					NO <sub>x</sub> Rate (lb/mmBtu)				
	2000	2005	2010	2020	2021	2000	2005	2010	2020	2021
Coal	4,587	3,356	1,896	569	624	0.44	0.32	0.20	0.14	0.13
Gas	355	167	142	160	146	0.18	0.06	0.04	0.03	0.03
Oil	162	104	20	2	3	0.31	0.25	0.13	0.10	0.20
Other	2	6	5	6	6	0.26	0.42	0.14	0.09	0.08
<b>Total / Average</b>	<b>5,104</b>	<b>3,633</b>	<b>2,063</b>	<b>737</b>	<b>779</b>	<b>0.40</b>	<b>0.27</b>	<b>0.16</b>	<b>0.07</b>	<b>0.07</b>

Notes:

- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only annual NO<sub>x</sub> program units are not included in the NO<sub>x</sub> emissions data prior to 2015.
- 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.
- The emission rate reflects the emissions (pounds) per unit of heat input (mmBtu) for each fuel category. The total annual NO<sub>x</sub> emission rate in each column of the table is not cumulative and does not equal the arithmetic mean of the four fuel-specific rates. The total for each year indicates the average rate across all units in the program because each unit influences the annual emission rate in proportion to its heat input, and heat input is unevenly distributed across the fuel categories.

Source: EPA, 2022

**Figure 4. CSAPR and ARP Annual NO<sub>x</sub> Emissions Trends, 2000-2021**

Notes:

- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only annual NO<sub>x</sub> program units are not included in the NO<sub>x</sub> emissions data prior to 2015.
- 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.
- The emission rate reflects the emissions (pounds) per unit of heat input (mmBtu) for each fuel category. The total annual NO<sub>x</sub> emission rate in each column of the table is not cumulative and does not equal the arithmetic mean of the four fuel-specific rates. The total for each year indicates the average rate across all units in the program because each unit influences the annual emission rate in proportion to its heat input, and heat input is unevenly distributed across the fuel categories.





## Ozone Season Nitrogen Oxides

### Highlights

#### Overall Results

- Ozone season NO<sub>x</sub> emissions have declined dramatically under the ARP, NBP, CAIR, and CSAPR programs.<sup>1</sup>
- States with the highest emitting sources of ozone season NO<sub>x</sub> emissions in 2000 have seen the greatest reductions under the CSAPR NO<sub>x</sub> ozone season programs. Most of these states are in the Ohio River Valley and are upwind of the areas CSAPR was designed to protect. Reductions by sources in these states have resulted in important [environmental and human health benefits over a large region](#).
- These reductions have occurred while electricity generation has remained relatively stable since 2000. These trends are discussed further in Chapter 1.
- Other programs – such as regional and state NO<sub>x</sub> emission control programs – also contributed significantly to the ozone season NO<sub>x</sub> emission reductions achieved by sources in 2021.

#### Ozone Season NO<sub>x</sub> Emissions Trends

- **ARP:** Units in the ARP program emitted 351,000 tons of ozone season NO<sub>x</sub> emissions in 2021. Sources reduced emissions by 1.8 million tons (84 percent) from the 2000 ozone season and 920,000 tons (72 percent) from the 2005 ozone season.
- **CSAPR:** In 2021, units covered under the CSAPR NO<sub>x</sub> ozone season programs (Groups 1, 2, and 3) emitted 242,000 tons, a reduction of 210,000 (46%) since 2015.
- In 2021, the CSAPR NO<sub>x</sub> ozone season program emissions were 19 percent below the regional emission budget of 298,879 tons (24,041 tons for Group 1, 143,408 tons for Group 2, and 131,430 tons for Group 3).

#### Ozone Season NO<sub>x</sub> State-by-State Emissions

- Between 2005 and 2021, ozone season NO<sub>x</sub> emissions from the CSAPR sources fell in every state participating in the CSAPR NO<sub>x</sub> ozone season program.
- 20 states had emissions below their CSAPR 2021 allowance budgets, collectively by about 62,000 tons. Three states (Illinois, Missouri, and Pennsylvania) exceeded their 2021 state level budgets by about 5,400 tons total.

#### Ozone Season NO<sub>x</sub> Emission Rates

- In 2021, the average NO<sub>x</sub> ozone season emission rate fell to 0.07 lb/mmBtu for the CSAPR ozone season program states and 0.07 lb/mmBtu nationally. This represents a 63 and 66 percent reduction, respectively, from 2005 emission rates, with the majority of reductions coming from coal-fired units.

<sup>1</sup> CSAPR refers to the CSAPR, the CSAPR Update, and the Revised CSAPR Update programs.



- Emissions have decreased dramatically since 2005, due in large part to greater use of control technology, primarily on coal-fired units, and increased generation at natural gas-fired units, which emit less NO<sub>x</sub> emissions per unit of electricity than coal-fired units.

### Background Information

Nitrogen oxides (NO<sub>x</sub>) are made up of a group of highly reactive gases that are emitted from power plants and motor vehicles, as well as other sources. NO<sub>x</sub> emissions contribute to the formation of ground-level ozone and fine particle pollution, which cause a variety of [adverse human health effects](#).

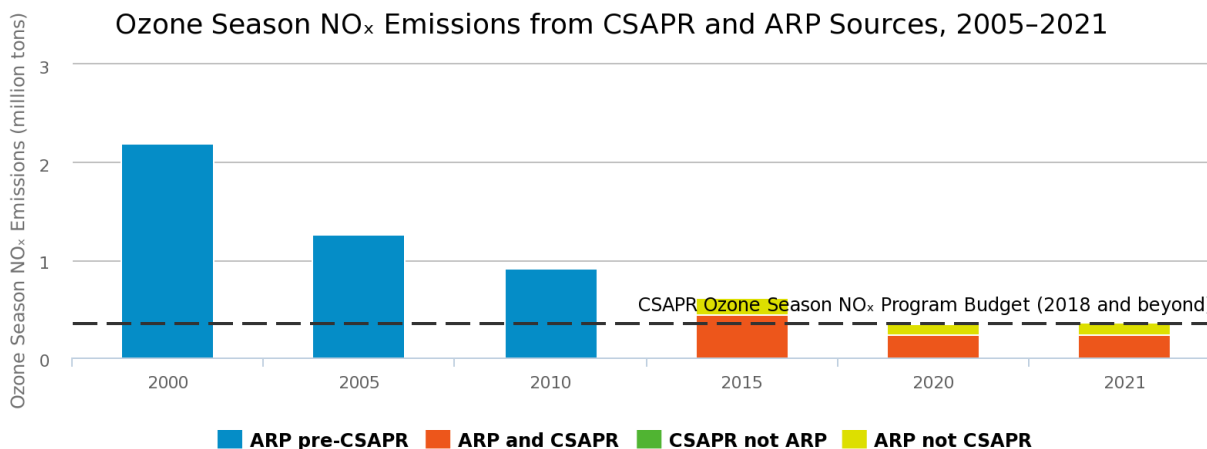
The CSAPR NO<sub>x</sub> ozone season program was established to reduce interstate transport of air pollution during the ozone season (May 1 – September 30), the warm summer months when ozone formation is highest, and to help eastern U.S. counties attain the 1997 ozone standard. The CSAPR Update NO<sub>x</sub> ozone season program was similarly established to help eastern U.S. counties attain the 2008 ozone standard. On March 15, 2021, EPA finalized the Revised CSAPR Update to further reduce NO<sub>x</sub> emissions from power plants in 12 states. The rule responded to a September 2019 ruling by the United States Court of Appeals for the D.C. Circuit, *Wisconsin v. EPA*, which remanded the 2016 CSAPR Update to EPA for failing to fully eliminate significant contribution to nonattainment and interference with maintenance of the 2008 ozone NAAQS from these states by downwind areas' attainment dates.

### More Information

- Power Plant Emission Trends <https://www.epa.gov/airmarkets/power-plant-emission-trends>
- Power Sector Emissions, Operations, and Environmental Data <https://www.epa.gov/airmarkets/data-resources>
- Cross-State Air Pollution Rule (CSAPR) <https://www.epa.gov/csapr>
- Pollution from Nitrogen Oxides (NO<sub>x</sub>) <https://www.epa.gov/no2-pollution>
- Pollution from Ozone <https://www.epa.gov/ozone-pollution>



## Figures



Notes:

- NO<sub>x</sub> values are shown as millions of tons.
- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only ozone season NO<sub>x</sub> program units are not included in the ozone season NO<sub>x</sub> data prior to 2015.
- There are a small number of sources in CSAPR but not in the ARP. Emissions from these sources comprise about 1 percent of total emissions and are not easily visible on the full chart.

Source: EPA, 2022

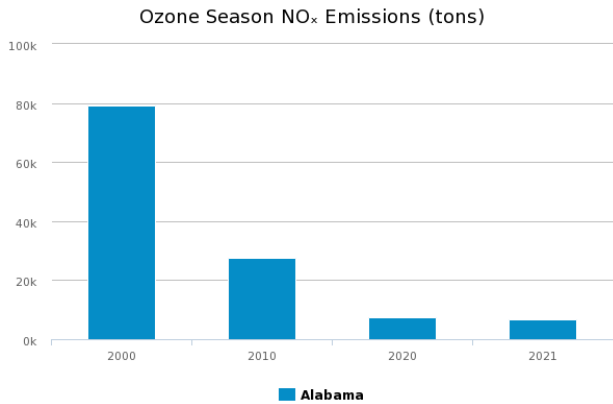
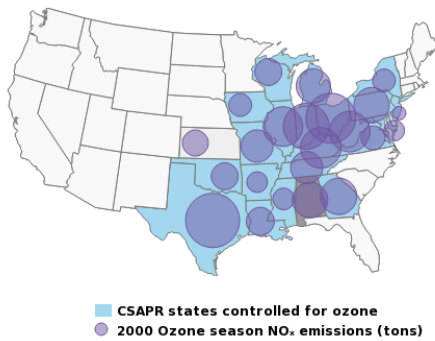
**Figure 1. Ozone Season NO<sub>x</sub> Emissions from CSAPR and ARP Sources, 2000–2021**

Notes:

- NO<sub>x</sub> values are shown as millions of tons.
- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only ozone season NO<sub>x</sub> program units are not included in the ozone season NO<sub>x</sub> data prior to 2015.
- There are a small number of sources in CSAPR but not in the ARP. Emissions from these sources comprise about 1 percent of total emissions and are not easily visible on the full chart.



State-by-State Ozone Season NO<sub>x</sub> Emissions from CSAPR and ARP Sources, 2000-2021



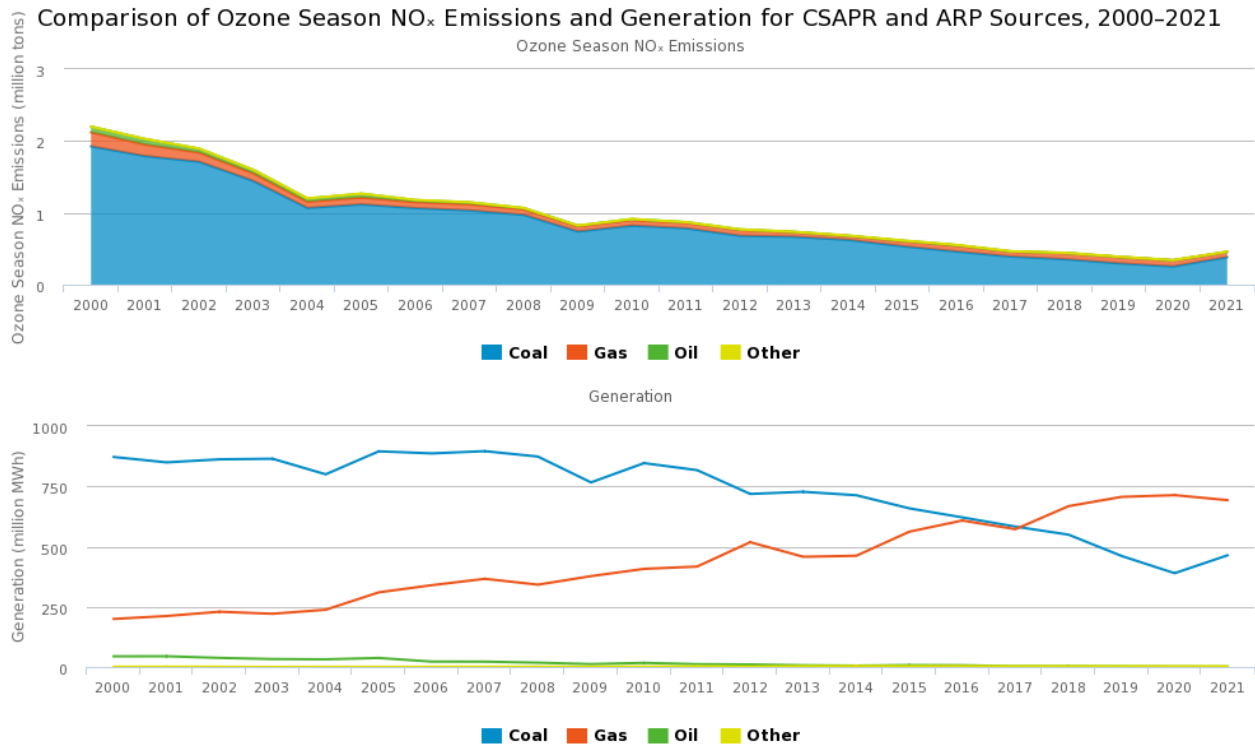
Notes:

• The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only ozone season NO<sub>x</sub> program units are not included in the ozone season NO<sub>x</sub> data prior to 2015. Source: EPA, 2022

**Figure 2. State-by-State Ozone Season NO<sub>x</sub> Emissions from CSAPR and ARP Sources, 2000–2021**

Notes:

• The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR-only ozone season NO<sub>x</sub> program units are not included in the ozone season NO<sub>x</sub> data prior to 2015.



Notes:

- The data shown here for the ozone season program reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR NO<sub>x</sub> ozone season only program units are not included in the ozone season NO<sub>x</sub> emissions data prior to 2015.
- Fuel type represents primary fuel type; units might combust more than one fuel.

Source: EPA, 2022

**Figure 3. Comparison of Ozone Season NO<sub>x</sub> Emissions and Generation for CSAPR and ARP Sources, 2000–2021**

Notes:

- The data shown here for the ozone season program reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR NO<sub>x</sub> ozone season only program units are not included in the ozone season NO<sub>x</sub> emissions data prior to 2015.
- Fuel type represents primary fuel type; units might combust more than one fuel.



CSAPR and ARP Ozone Season NO<sub>x</sub> Emissions Trends, 2021

Primary Fuel	Ozone Season NO <sub>x</sub> Emissions (thousand tons)					Ozone Season NO <sub>x</sub> Rate (lb/mmBtu)				
	2000	2005	2010	2020	2021	2000	2005	2010	2020	2021
Coal	1,926	1,117	821	253	282	0.43	0.25	0.19	0.13	0.12
Gas	196	96	79	85	73	0.19	0.07	0.04	0.03	0.03
Oil	78	52	12	1	1	0.31	0.25	0.13	0.09	0.13
Other	1	2	2	2	3	0.25	0.40	0.11	0.08	0.09
<b>Total / Average</b>	<b>2,201</b>	<b>1,267</b>	<b>914</b>	<b>341</b>	<b>359</b>	<b>0.38</b>	<b>0.20</b>	<b>0.15</b>	<b>0.07</b>	<b>0.07</b>

Notes:

- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR NO<sub>x</sub> ozone season only program units are not included in the ozone season NO<sub>x</sub> emissions data prior to 2015.
- 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.
- The emission rate reflects the emissions (pounds) per unit of heat input (mmBtu) for each fuel category. The total NO<sub>x</sub> ozone season emission rate in each column of the table is not cumulative and does not equal the arithmetic mean of the four fuel-specific rates. The total for each year indicates the average rate across all units in the program because each unit influences the annual emission rate in proportion to its heat input, and heat input is unevenly distributed across the fuel categories.

Source: EPA, 2022

**Figure 4. CSAPR Ozone Season NO<sub>x</sub> Emissions Trends, 2000-2021**

Notes:

- The data shown here reflect totals for those units required to comply with each program in each respective year. This means that the CSAPR NO<sub>x</sub> ozone season only program units are not included in the ozone season NO<sub>x</sub> emissions data prior to 2015.
- 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.
- The emission rate reflects the emissions (pounds) per unit of heat input (mmBtu) for each fuel category. The total NO<sub>x</sub> ozone season emission rate in each column of the table is not cumulative and does not equal the arithmetic mean of the four fuel-specific rates. The total for each year indicates the average rate across all units in the program because each unit influences the annual emission rate in proportion to its heat input, and heat input is unevenly distributed across the fuel categories.



# Mercury

## Highlights

### Overall Results

- Mercury and other hazardous air pollutant (HAP) emissions have declined significantly since 2010 estimates. These emission reductions were driven by the installation of new pollution controls and enhancements of existing pollution controls that reduce multiple pollutants. Emissions have also decreased due to operational changes, such as fuel switching and increased generation at natural gas-fired units that emit very little mercury and other HAPs. These trends are discussed in Chapter 1.
- Other programs – such as regional and state SO<sub>2</sub> and NO<sub>x</sub> emission control programs – also contributed to the mercury and other HAP emission reductions achieved by covered sources in 2021.

### Mercury and Hazardous Air Pollutant Emission Trends

- Compared to 2010<sup>1</sup>, units covered under MATS in 2021 emitted 26 fewer tons of mercury (90% reduction).

## Background Information

Hazardous air pollutants (HAPs) emitted by power plants include mercury, acid gases (e.g., hydrochloric acid, hydrofluoric acid), non-mercury metallic toxics (e.g., arsenic, nickel, and chromium), and organic HAPs (e.g., formaldehyde, dioxin/furan). Exposure to these pollutants at certain concentrations and durations can increase chances of neurological and developmental effects, cancer, and reproductive, respiratory, and other health problems.

In 2011, EPA issued MATS, establishing national emission standards for mercury and other hazardous air pollutants for new and existing coal- and oil-fired power plants. The standards were finalized under section 112 of the Clean Air Act. The MATS emission standards were established using data from a 2010 information collection request that was sent to selected coal and oil burning power plants.

## More Information

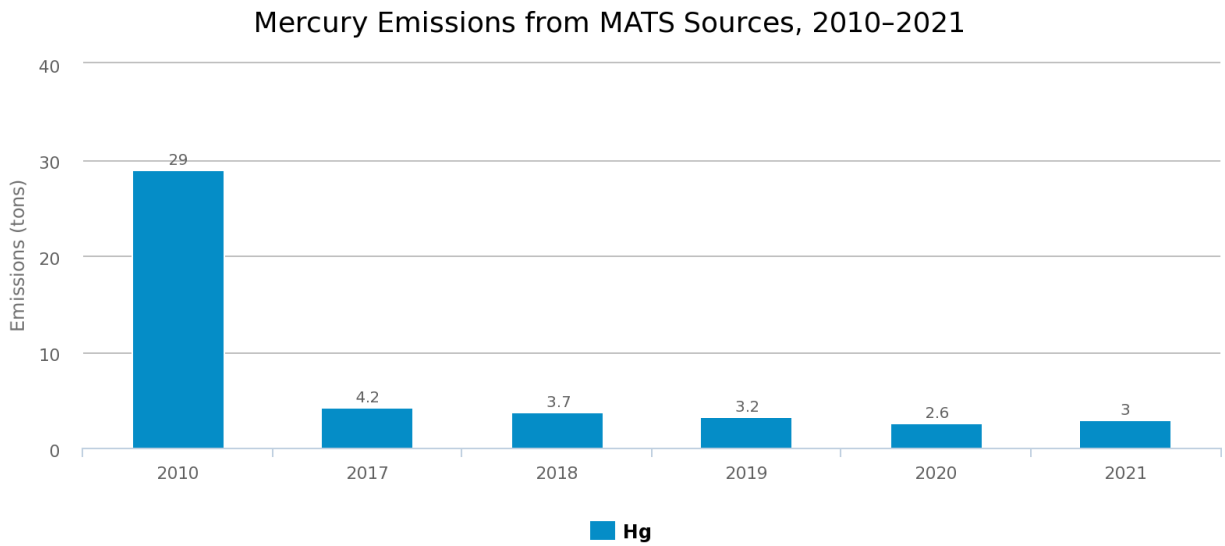
- Power Sector Emissions, Operations, and Environmental Data <https://www.epa.gov/airmarkets/data-resources>
- Mercury and Air Toxics Standards (MATS) <https://www.epa.gov/stationary-sources-air-pollution/mercury-and-air-toxics-standards>
- Hazardous Air Pollutants (HAPs) <https://www.epa.gov/haps>

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<sup>1</sup> Emissions from 2010 are estimated as described in *Memorandum: Emissions Overview: Hazardous Air Pollutants in Support of the Final Mercury and Air Toxics Standard*. EPA-454/R-11-014. November 2011; Docket ID No. EPA-HQ-OAR-2009-0234-19914.



## Figures



Notes:

- Mercury emissions data are not available for 79 low emitting electricity generating units (LEEs).

Source: EPA, 2022

**Figure 1. Mercury Emissions from MATS Sources, 2010–2021**

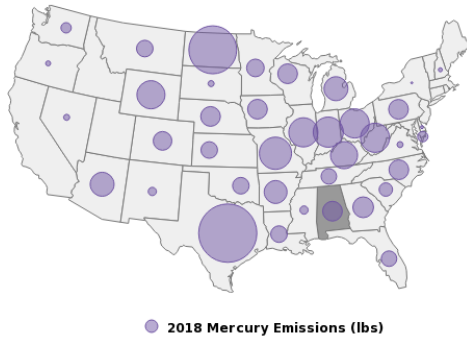
Notes:

- Mercury emissions data are not available for 79 low emitting electricity generating units (LEEs).



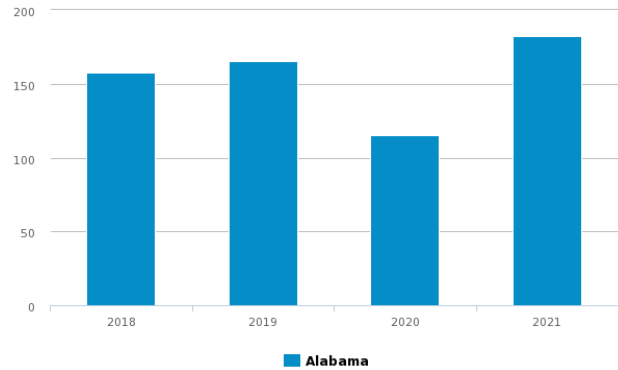


State-by-State Mercury Emissions from MATS Sources, 2018-2021



Notes:  
• Data do not include emissions from low emitting electric generating units (LEEs).  
• Data for Alaska are not displayed on the map above. They are available in the Data Download.

Mercury Emissions (lbs)



Source: EPA, 2022

**Figure 2. State-by-State Mercury Emissions from MATS Sources, 2021**

Notes:

- Data do not include emissions from low emitting electric generating units (LEEs).
- Data for Alaska are not displayed on the map above. They are available in the Data Download.



## Chapter 4: Emission Controls and Monitoring

Many sources opted to install control technologies to meet the Acid Rain Program (ARP) and Cross-State Air Pollution Rule (CSAPR) emission reduction targets.<sup>1</sup> A wide range of controls is available to help reduce emissions. Affected units under the Mercury and Air Toxics Standards (MATS) also have several options for reducing hazardous air pollutants and have some flexibility in how they monitor emissions. These programs hold sources to high standards of accountability for emissions. Accurate and consistent emissions monitoring data are critical to ensure program results and accountability. Most emissions from affected sources are measured by continuous emission monitoring systems (CEMS).

### Highlights

#### ARP and CSAPR SO<sub>2</sub> Program Controls and Monitoring

- Units with advanced flue gas desulfurization (FGD) controls (also known as scrubbers) accounted for 71 percent of coal-fired units and 81 percent of coal-fired electricity generation, measured in megawatt hours, or MWh, in 2021.
- In 2021, 20 percent of the CSAPR units (including 100 percent of coal-fired units) monitored SO<sub>2</sub> emissions using CEMS. Ninety-nine percent of SO<sub>2</sub> emissions were measured by CEMS.

#### CSAPR NO<sub>x</sub> Annual Program Controls and Monitoring

- Eighty-one percent of fossil fuel-fired generation was produced by units with advanced add-on controls (either selective catalytic reduction [SCR] or selective non-catalytic reduction [SNCR]).
- In 2021, the 236 coal-fired units with advanced add-on controls (either SCRs or SNCRs) generated 78 percent of coal-fired electricity. At oil- and natural gas-fired units, SCR- and SNCR-controlled units produced 84 percent of electricity generation.
- In 2021, 67 percent of the CSAPR units (including 100 percent of coal-fired units) monitored NO<sub>x</sub> emissions using CEMS. Ninety-seven percent of NO<sub>x</sub> emissions were measured by CEMS.

#### CSAPR NO<sub>x</sub> Ozone Season Program Controls and Monitoring

- Seventy-three percent of all the fossil fuel-fired generation was produced by units with advanced add-on controls (either SCRs or SNCRs).
- In 2021, 213 units with advanced add-on controls (either SCR or SNCR) accounted for 71 percent of coal-fired electricity generation. At oil- and natural gas-fired units, SCR- and SNCR-controlled units produced 75 percent of electricity generation.
- In 2020, 73 percent of the CSAPR units (including 100 percent of coal-fired units) monitored ozone season NO<sub>x</sub> emissions using CEMS. Ninety-seven percent of ozone season NO<sub>x</sub> emissions were measured by CEMS.

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<sup>1</sup> CSAPR refers to the CSAPR, the CSAPR Update, and the Revised CSAPR Update programs.



### MATS Controls and Monitoring

- In 2021, forty-six percent of the MATS units reporting mercury emissions and 52 percent of the electricity generation at the MATS reporting units used activated carbon injection (ACI), a mercury-specific pollution control method to reduce mercury emissions and SO<sub>2</sub>.
- About 81 percent of units that reported continuous mercury emissions data (or 82 percent of the total electricity generation from units that reported data) reported the use of advanced controls, such as wet scrubbers, dry scrubbers, or ACI, to reduce hazardous air pollutant emissions in 2021. These controls also reduce other pollutants, including SO<sub>2</sub>. Some oil-fired units can meet the MATS emission limits through the use of particulate matter (PM) controls such as electrostatic precipitators (ESPs) or fabric filters (FFs).

## Background Information

### Continuous Emission Monitoring Systems (CEMS)

EPA has developed detailed procedures codified in federal regulations (40 CFR Part 75) to ensure that sources monitor and report emissions with a high degree of precision, reliability, accuracy, and timeliness. Sources are required to use CEMS or other approved methods to record and report pollutant emissions data. Sources conduct stringent quality assurance tests of their monitoring systems to ensure the accuracy of emissions data and to provide assurance to market participants that a quantity of emissions measured at one facility is equivalent to the same quantity measured at a different facility. EPA conducts comprehensive electronic and desk data audits to validate the reported data. While some units with low levels of SO<sub>2</sub> or NO<sub>x</sub> emissions are allowed to use other approved monitoring methods, the vast majority of SO<sub>2</sub> and NO<sub>x</sub> emissions are measured by CEMS.

Affected units have a variety of monitoring options, but most use either CEMS or sorbent traps for mercury (Hg). Some qualifying units with low emissions can conduct periodic stack tests in lieu of continuous monitoring.

### SO<sub>2</sub> Emission Controls

Sources in the ARP or the CSAPR SO<sub>2</sub> programs have a number of SO<sub>2</sub> emission control options available. These include switching to low sulfur coal or natural gas, employing various types of FGDs, or, in the case of fluidized bed boilers, injecting limestone into the furnace. FGDs on coal-fired electricity generating units are the principal means of controlling SO<sub>2</sub> emissions and tend to be present on the highest generating coal-fired units.

### NO<sub>x</sub> Emission Controls

Sources in the ARP or the CSAPR NO<sub>x</sub> annual and ozone season programs have a variety of options by which to reduce NO<sub>x</sub> emissions, including advanced add-on controls such as SCR or SNCR, and combustion controls, such as low NO<sub>x</sub> burners.

### Hazardous Air Pollutant Controls

Sources in MATS have a number of options available to reduce hazardous air pollutants (HAPs), including mercury, PM (a surrogate for toxic non-mercury metals), HCl, HF, and other acid gases. Sources can improve operation of existing controls, add pollution controls, and switch fuels (including coal blending).

## 2021 Power Sector Programs – Progress Report

[https://www3.epa.gov/airmarkets/progress/reports/emission\\_controls\\_and\\_monitoring.html](https://www3.epa.gov/airmarkets/progress/reports/emission_controls_and_monitoring.html)



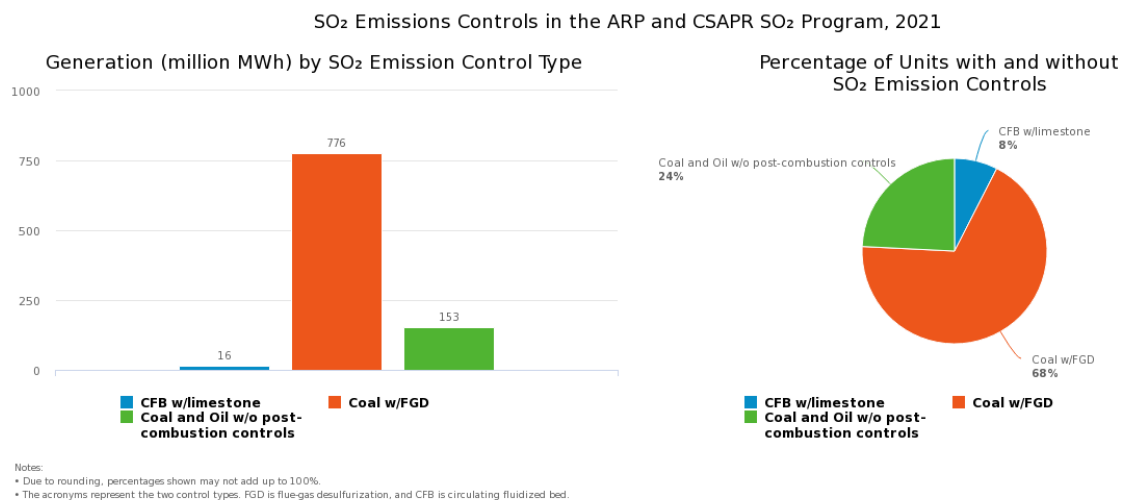
Specific pollution control devices that reduce mercury and HCl include wet FGDs, activated carbon injection (ACI), dry sorbent injection (DSI), and fabric filters.

### More Information

- Power Plant Emission Trends <https://www.epa.gov/airmarkets/power-plant-emission-trends>
- Power Sector Emissions, Operations, and Environmental Data <https://www.epa.gov/airmarkets/data-resources>
- Emissions Monitoring <https://www.epa.gov/airmarkets/emissions-monitoring-and-reporting>
- Plain English guide to 40 CFR Part 75 <https://www.epa.gov/airmarkets/plain-english-guide-part-75-rule>
- Continuous Emission Monitoring Systems (CEMS) <https://www.epa.gov/emc/emc-continuous-emission-monitoring-systems>



## Figures



Source: EPA, 2022

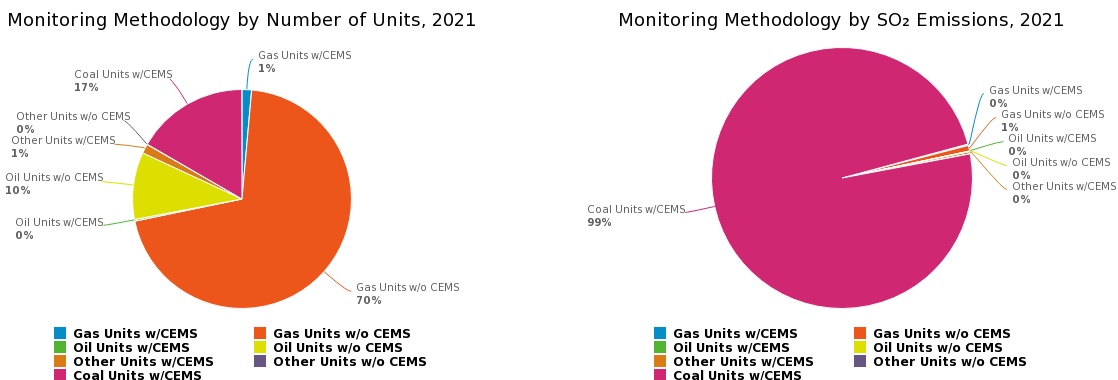
**Figure 1. SO<sub>2</sub> Emissions Controls in the ARP and CSAPR SO<sub>2</sub> Program, 2021**

**Notes:**

- Due to rounding, percentages shown may not add up to 100%.
- The acronyms represent the two control types. FGD is flue-gas desulfurization, and CFB is circulating fluidized bed.



CSAPR SO<sub>2</sub> Program Monitoring Methodology, 2021



Notes:

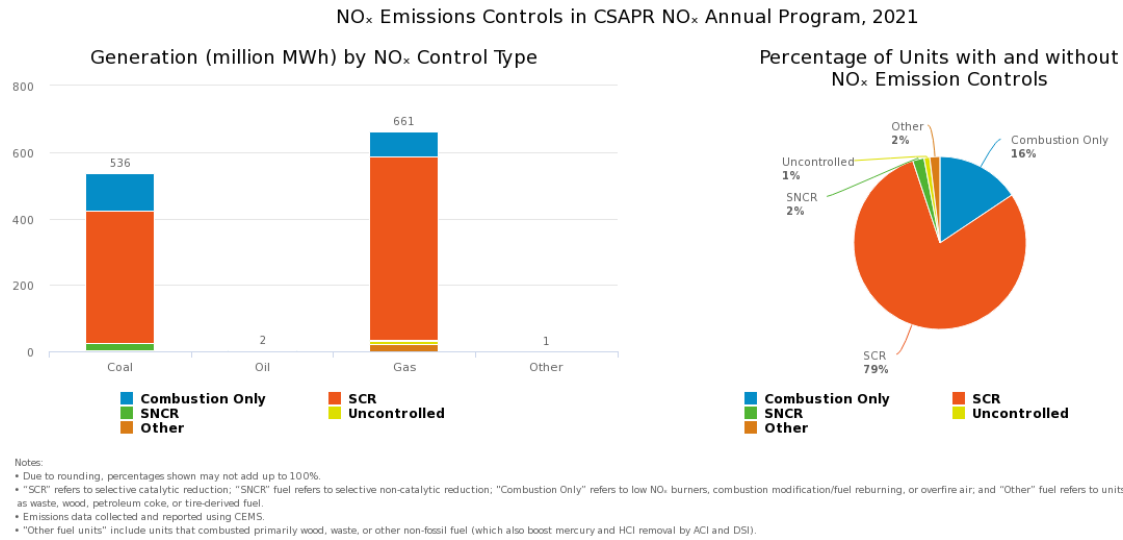
- This figure displays CSAPR units which reported SO<sub>2</sub> emissions in 2021, with a breakdown by SO<sub>2</sub> monitoring methodology and primary fuel type group (coal, gas, oil, and other). The total number of CSAPR units that reported SO<sub>2</sub> emissions in 2021 was 2,125. Among those, 418 units monitored SO<sub>2</sub> using CEMS, and 354 are coal-fired units.
- Percent totals may not add up to 100 percent due to rounding.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).

Source: EPA, 2022

**Figure 2. CSAPR SO<sub>2</sub> Program Monitoring Methodology, 2021**

Notes:

- This figure displays CSAPR units which reported SO<sub>2</sub> emissions in 2021, with a breakdown by SO<sub>2</sub> monitoring methodology and primary fuel type group (coal, gas, oil, and other). The total number of CSAPR units that reported SO<sub>2</sub> emissions in 2021 was 2,125. Among those, 418 units monitored SO<sub>2</sub> using CEMS, and 354 are coal-fired units.
- Percent totals may not add up to 100 percent due to rounding.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).



Source: EPA, 2022

**Figure 3. NO<sub>x</sub> Emissions Controls in CSAPR NO<sub>x</sub> Annual Program, 2021**

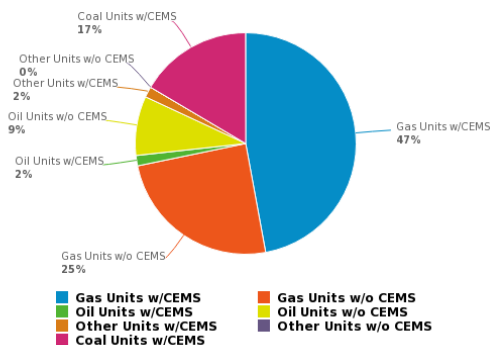
Notes:

- Due to rounding, percentages shown may not add up to 100%.
- "SCR" refers to selective catalytic reduction; "SNCR" fuel refers to selective non-catalytic reduction; "Combustion Only" refers to low NO<sub>x</sub> burners, combustion modification/fuel reburning, and/or overfire air; and "Other" fuel refers to units that burn fuels such as waste, wood, petroleum coke, or tire-derived fuel.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).

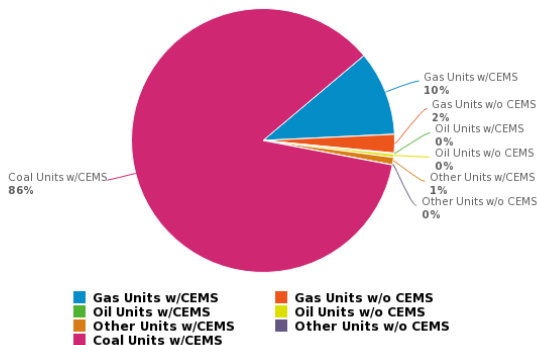


CSAPR NO<sub>x</sub> Annual Program Monitoring Methodology, 2021

Monitoring Methodology by Number of Units, 2021



Monitoring Methodology by NO<sub>x</sub> Emissions, 2021



Notes:

- This figure displays CSAPR units which reported NO<sub>x</sub> emissions in 2021, with a breakdown by NO<sub>x</sub> monitoring methodology and primary fuel type group (coal, gas, oil, and other). The total number of CSAPR units that reported NO<sub>x</sub> emissions in 2021 was 2,125. Among those, 1,417 units monitored NO<sub>x</sub> using CEMS, and 351 are coal-fired units.
- Percent totals may not add up to 100 percent due to rounding.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).

Source: EPA, 2022

**Figure 4. CSAPR NO<sub>x</sub> Annual Program Monitoring Methodology, 2021**

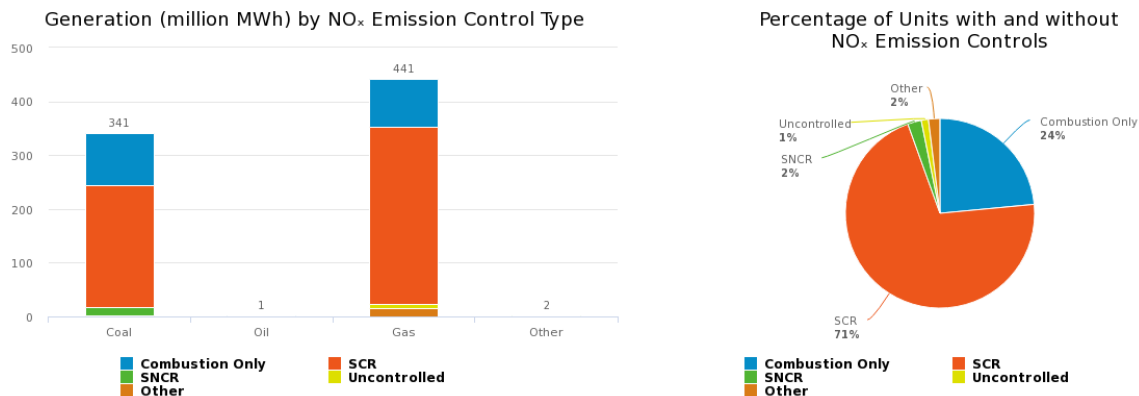
Notes:

- This figure displays CSAPR units which reported NO<sub>x</sub> emissions in 2021, with a breakdown by NO<sub>x</sub> monitoring methodology and primary fuel type group (coal, gas, oil, and other). The total number of CSAPR units that reported NO<sub>x</sub> emissions in 2021 was 2,125. Among those, 1,417 units monitored NO<sub>x</sub> using CEMS, and 351 are coal-fired units.
- Percent totals may not add up to 100 percent due to rounding.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).





NO<sub>x</sub> Emissions Controls in CSAPR NO<sub>x</sub> Ozone Season Program, 2021



Notes:

- Due to rounding, percentages shown may not add up to 100%.
- "SCR" refers to selective catalytic reduction; "SNCR" fuel refers to selective non-catalytic reduction; "Combustion Only" refers to low NO<sub>x</sub> burners, combustion modification/fuel reburning, and/or overfire air; and "Other" fuel refers to units that burn fuels such as waste, wood, petroleum coke, and tire-derived fuel.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).
- There is a small amount of generation from units with "Other" controls and from "Uncontrolled" units. The data for these units is not easily visible on the full chart. To more clearly see the generation data for these units, especially for Uncontrolled and Other fuel types, use the interactive features of the figure: click on the boxes in the legend to turn off the blue, dark orange, and green categories of control types (labeled "Combustion Only," "SCR," and "SNCR") and turn on the yellow and light orange categories of control types (labeled "Uncontrolled" "Other").

Source: EPA, 2022

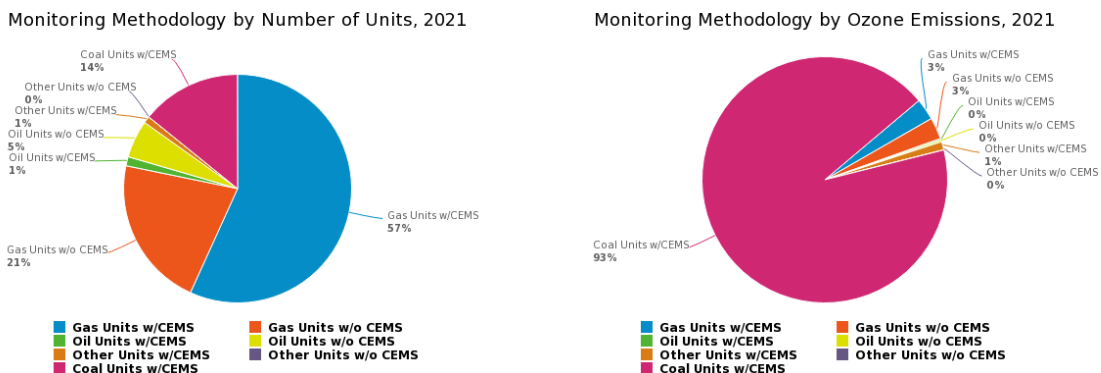
**Figure 5. NO<sub>x</sub> Emissions Controls in the CSAPR NO<sub>x</sub> Ozone Season Program, 2021**

Notes:

- Due to rounding, percentages shown may not add up to 100%.
- "SCR" refers to selective catalytic reduction; "SNCR" fuel refers to selective non-catalytic reduction; "Combustion Only" refers to low NO<sub>x</sub> burners, combustion modification/fuel reburning, and/or overfire air; and "Other" fuel refers to units that burn fuels such as waste, wood, petroleum coke, and tire-derived fuel.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).
- There is a small amount of generation from units with "Other" controls and from "Uncontrolled" units. The data for these units is not easily visible on the full chart. To more clearly see the generation data for these units, especially for Uncontrolled and Other fuel types, use the interactive features of the figure: click on the boxes in the legend to turn off the blue, dark orange, and green categories of control types (labeled "Combustion Only," "SCR," and "SNCR") and turn on the yellow and light orange categories of control types (labeled "Uncontrolled" "Other").



CSAPR NO<sub>x</sub> Ozone Season Program Monitoring Methodology, 2021



Notes:  
 • This figure displays CSAPR units which reported ozone season NO<sub>x</sub> emissions in 2021, with a breakdown by ozone season NO<sub>x</sub> monitoring methodology and primary fuel type group (coal, gas, oil, and other). The total number of CSAPR units that reported ozone season NO<sub>x</sub> emissions in 2021 was 2,499. Among those, 1,816 units monitored NO<sub>x</sub> using CEMS, and 352 are coal-fired units.  
 • Percent totals may not add up to 100 percent due to rounding.  
 • "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).

Source: EPA, 2022

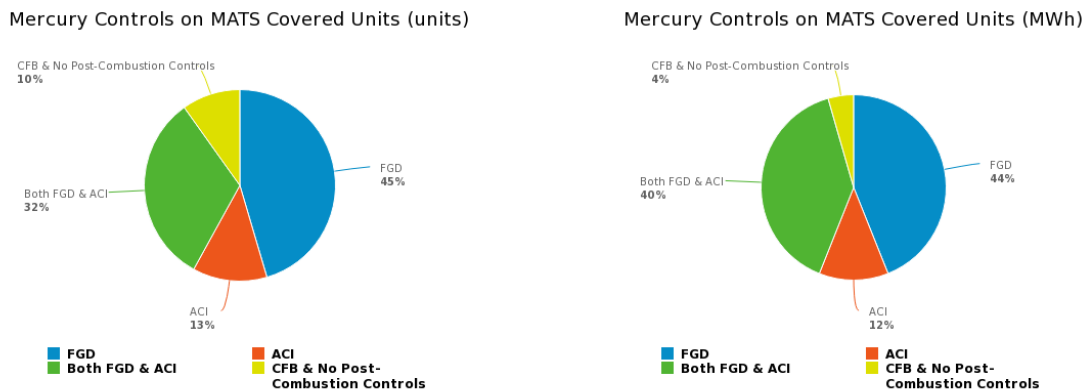
**Figure 6. CSAPR NO<sub>x</sub> Ozone Season Program Monitoring Methodology, 2021**

Notes:

- This figure displays CSAPR units which reported ozone season NO<sub>x</sub> emissions in 2021, with a breakdown by ozone season NO<sub>x</sub> monitoring methodology and primary fuel type group (coal, gas, oil, and other). The total number of CSAPR units that reported ozone season NO<sub>x</sub> emissions in 2021 was 2,499. Among those, 1,816 units monitored NO<sub>x</sub> using CEMS, and 352 are coal-fired units.
- Percent totals may not add up to 100 percent due to rounding.
- "Other fuel units" include units that combusted primarily wood, waste, or other non-fossil fuel (which also boost mercury and HCl removal by ACI and DSI).



Mercury Controls at MATS-Affected Sources, 2021



Notes:  
 • Percent totals may not add up to 100 percent due to rounding.  
 • This data is from the MATS-affected sources that submitted hourly emissions data to EPA. Units not reporting data (e.g. those monitoring using periodic testing) are not included in this report.

Source: EPA, 2022

Figure 7. Mercury Controls at MATS-Affected Sources, 2021

Notes:

- Percent totals may not add up to 100 percent due to rounding.
- This data is from the MATS-affected sources that submitted hourly emissions data to EPA. Units not reporting data (e.g., those monitoring using periodic testing) are not included in this report.



Mercury Compliance and Monitoring Methods used by Units Reporting Hourly Data under MATS, 2021

Reporting Hourly Data		Compliance Method (# of Units)		Monitoring Method		
Number of reporting units	Number of reporting facilities	Electrical Output	Heat Input	Sorbent Trap	CEMS	CEMS and Sorbent Trap
405	186	115	290	177	187	41

Notes:

• This data is from the MATS-affected sources that submitted hourly emissions data to EPA and does not show complete data from all the MATS-affected sources because many sources received compliance extensions or chose to demonstrate compliance through methods other than continuously monitored emissions.

Source: EPA, 2022  
Last updated: 05/2022

**Figure 8. Mercury Compliance and Monitoring Methods used by Units Reporting Hourly Data under MATS, 2021**

Notes:

• This data is from the MATS-affected sources that submitted hourly emissions data to EPA and does not show complete data from all the MATS-affected sources because many sources received compliance extensions or chose to demonstrate compliance through methods other than continuously monitored emissions.



## Chapter 5: Program Compliance

Compliance for the Acid Rain Program (ARP) and each of the Cross-State Air Pollution Rule (CSAPR)<sup>1</sup> trading programs is assessed on an annual basis. Each regulated facility must hold an amount of allowances equal to or greater than its emissions for the relevant compliance period. Historically, these programs have had exceptionally high rates of compliance. This performance continued in 2021 as 100% of the facilities in each of these programs held sufficient allowances to cover their emission obligations.

The information below details how the ARP and CSAPR allowances were used for compliance under the emissions trading programs in 2021. In contrast to the ARP and CSAPR,<sup>1</sup> the Mercury and Air Toxics Standards (MATS) rule is issued under section 112 of the Clean Air Act and is not an emissions trading program.

### Highlights

#### ARP SO<sub>2</sub> Program

- All [ARP SO<sub>2</sub> facilities](#) were in compliance in 2021, holding sufficient allowances to cover their SO<sub>2</sub> emissions.
- ARP sources reported total SO<sub>2</sub> emissions of 935,750 tons in 2021.
- EPA deducted 935,703 allowances for compliance with the ARP. After reconciliation, over 71 million ARP SO<sub>2</sub> allowances remain unused and were banked.

#### CSAPR SO<sub>2</sub> Group 1 Program

- All [CSAPR SO<sub>2</sub> Group 1 facilities](#) were in compliance in 2021, holding sufficient allowances to cover their SO<sub>2</sub> emissions.
- CSAPR SO<sub>2</sub> Group 1 sources reported total SO<sub>2</sub> emissions of 518,858 tons in 2021.
- EPA deducted 518,867 allowances for the CSAPR SO<sub>2</sub> Group 1 compliance. After reconciliation, about 6.6 million CSAPR SO<sub>2</sub> Group 1 allowances remain unused and were banked.

#### CSAPR SO<sub>2</sub> Group 2 Program

- All [CSAPR SO<sub>2</sub> Group 2 facilities](#) were in compliance in 2021, holding sufficient allowances to cover their SO<sub>2</sub> emissions.
- CSAPR SO<sub>2</sub> Group 2 sources reported total SO<sub>2</sub> emissions of 73,572 tons in 2021.
- EPA deducted 73,565 allowances for the CSAPR SO<sub>2</sub> Group 2 compliance. After reconciliation, about 3.4 million CSAPR SO<sub>2</sub> Group 2 allowances remain unused and were banked.

#### CSAPR NO<sub>x</sub> Annual Program

- All [CSAPR NO<sub>x</sub> Annual Program facilities](#) were in compliance in 2021, holding sufficient allowances to cover their NO<sub>x</sub> emissions.

<sup>1</sup> CSAPR refers to the CSAPR, the CSAPR Update, and the Revised CSAPR Update programs.



- CSAPR annual NO<sub>x</sub> sources reported total NO<sub>x</sub> emissions of 440,051 tons in 2021.
- EPA deducted 440,184 allowances for the CSAPR NO<sub>x</sub> Annual Program compliance. After reconciliation, about 3.4 million CSAPR NO<sub>x</sub> Annual Program allowances remain unused and were banked.

### CSAPR NO<sub>x</sub> Ozone Season Group 1 Program

- All [CSAPR NO<sub>x</sub> Ozone Season Group 1 facilities](#) were in compliance in 2021, holding sufficient allowances to cover their NO<sub>x</sub> emissions.
- CSAPR NO<sub>x</sub> Ozone Season Group 1 sources reported total ozone season NO<sub>x</sub> emissions of 6,150 tons in 2021.
- EPA deducted 6,154 allowances for the CSAPR NO<sub>x</sub> Ozone Season Group 1 compliance. After reconciliation, over 105,000 CSAPR NO<sub>x</sub> Ozone Season Group 1 allowances remain unused and were banked.

### CSAPR NO<sub>x</sub> Ozone Season Group 2 Program

- All [CSAPR NO<sub>x</sub> Ozone Season Group 2 facilities](#) were in compliance in 2021, holding sufficient allowances to cover their NO<sub>x</sub> emissions.
- CSAPR NO<sub>x</sub> Ozone Season Group 2 sources reported total ozone season NO<sub>x</sub> emissions of 121,838 tons in 2021.
- EPA deducted 121,877 allowances for the CSAPR NO<sub>x</sub> Ozone Season Group 2 compliance. After reconciliation, over 157,000 CSAPR NO<sub>x</sub> Ozone Season Group 2 allowances remain unused and were banked.
- Based on preliminary calculations, in 2021, Missouri units covered by the CSAPR Ozone Season NO<sub>x</sub> Group 2 Program reported emissions exceeding the state's assurance level, triggering the assurance provisions. Emissions in Missouri exceeded the state's assurance level by 1,289 tons, resulting in the surrender of 2,578 additional allowances.<sup>2</sup>

### CSAPR NO<sub>x</sub> Ozone Season Group 3 Program

- All [CSAPR NO<sub>x</sub> Ozone Season Group 3 facilities](#) were in compliance for 2021, holding sufficient allowances to cover NO<sub>x</sub> emissions.
- CSAPR NO<sub>x</sub> Ozone Season Group 3 sources reported total ozone season NO<sub>x</sub> emissions of 114,293 tons in 2021.
- EPA deducted over 114,337 allowances for the CSAPR NO<sub>x</sub> Ozone Season Group 3 compliance. After reconciliation, about 30,000 CSAPR NO<sub>x</sub> Ozone Season Group 3 allowances remain unused and were banked.

## Background Information

The year 2021 was the seventh year of compliance for the CSAPR SO<sub>2</sub> (Group 1 and Group 2), NO<sub>x</sub> Annual and NO<sub>x</sub> Ozone Season Group 1 programs, while it was the fifth year of compliance for the

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<sup>2</sup> See 87 Fed. Reg. 42459.



CSAPR NO<sub>x</sub> Ozone Season Group 2 program and the first year of compliance for the CSAPR NO<sub>x</sub> Ozone Season Group 3 program. Each program has its own distinct set of allowances, which cannot be used for compliance with the other programs (e.g., CSAPR SO<sub>2</sub> Group 1 allowances cannot be used to comply with the CSAPR SO<sub>2</sub> Group 2 Program). Each CSAPR trading program contains “assurance provisions” to guarantee that each covered state achieves the required emissions reductions. If a state’s covered units exceed the state’s assurance level under the specific trading program, then the state must surrender two allowances for each ton of emissions exceeding the assurance level.

The compliance summary emissions number cited in “Highlights” may differ slightly from the sums of emissions used for reconciliation purposes shown in the “Allowance Reconciliation Summary” figures because of variation in rounding conventions and compliance issues at certain units. Therefore, the allowance totals deducted for actual emissions in those figures differ slightly from the number of emissions shown elsewhere in this report.

### More Information

- Allowance Markets <https://www.epa.gov/airmarkets/allowance-markets>
- Air Markets Business Center <https://www.epa.gov/airmarkets/business-center>
- Clean Air Markets Program Data (CAMPD) <https://campd.epa.gov>
- Emissions Trading <https://www.epa.gov/emissions-trading-resources>



## Figures

ARP SO<sub>2</sub> Program Allowance Reconciliation Summary, 2021

<b>Total Allowances Held (1995-2021 Vintage)</b>	<b>72,424,252</b>	Held by Affected Facility Accounts	<b>42,606,024</b>
		Held by Other Accounts (General and Non-Affected Facility Accounts)	<b>29,818,228</b>
Allowances Deducted for ARP Compliance*	935,703		
Penalty Allowance Deduction	0		
<b>Banked Allowances</b>	<b>71,488,549</b>	Held by Affected Facility Accounts	<b>41,670,321</b>
		Held by Other Accounts (General and Non-Affected Facility Accounts)	<b>29,818,228</b>
* Includes allowances deducted from opt-in for reduced utilization.			
<b>Acid Rain Program Compliance Results</b>			
Reported Emissions (tons)	935,750		
Rounding and compliance issues (tons)	-47		
Emissions not covered by allowances (tons)	0		
Total allowances deducted for emissions	935,703		

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.

Source: EPA, 2022

**Figure 1. ARP SO<sub>2</sub> Program Allowance Reconciliation Summary, 2021**

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.





CSAPR SO<sub>2</sub> Group 1 Program Allowance Reconciliation Summary, 2021

<b>Total Allowances Held (2015-2021 Vintage)</b>	7,168,328	Held by Affected Facility Accounts	5,491,118
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	1,677,210
Allowances Deducted for CSAPR SO <sub>2</sub> Group 1 Program	518,867		
Penalty Allowance Deduction	0		
<b>Banked Allowances</b>	6,649,461	Held by Affected Facility Accounts	4,972,251
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	1,677,210
<b>CSAPR SO<sub>2</sub> Group 1 Program Compliance Results</b>			
Reported Emissions (tons)	518,858		
Rounding and compliance issues (tons)	9		
Emissions not covered by allowances (tons)	0		
Total allowances deducted for emissions	518,867		

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.

Source: EPA, 2022

**Figure 2. CSAPR SO<sub>2</sub> Group 1 Program Allowance Reconciliation Summary, 2021**

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.



CSAPR SO<sub>2</sub> Group 2 Program Allowance Reconciliation Summary, 2021

<b>Total Allowances Held (2015-2021 Vintage)</b>	<b>3,536,164</b>	Held by Affected Facility Accounts	<b>2,770,959</b>
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	<b>765,205</b>
Allowances Deducted for CSAPR SO <sub>2</sub> Group 2 Program	73,565		
Penalty Allowance Deduction	0		
<b>Banked Allowances</b>	<b>3,462,599</b>	Held by Affected Facility Accounts	<b>2,697,394</b>
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	<b>765,205</b>
<b>CSAPR SO<sub>2</sub> Group 2 Program Compliance Results</b>			
Reported Emissions (tons)	73,572		
Rounding and compliance issues (tons)	-7		
Emissions not covered by allowances (tons)	0		
Total allowances deducted for emissions	73,565		

Notes:  
 • Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.  
 • Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.

Source: EPA, 2022

**Figure 3. CSAPR NO<sub>x</sub> Annual Program Allowance Reconciliation Summary, 2021**

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.

## 2021 Power Sector Programs – Progress Report

[https://www3.epa.gov/airmarkets/progress/reports/program\\_compliance.html](https://www3.epa.gov/airmarkets/progress/reports/program_compliance.html)



### CSAPR NO<sub>x</sub> Annual Program Allowance Reconciliation Summary, 2021

<b>Total Allowances Held (2015-2021 Vintage)</b>	<b>3,889,515</b>	Held by Affected Facility Accounts	<b>3,058,849</b>
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	<b>830,666</b>
Allowances Deducted for CSAPR NO <sub>x</sub> Annual Program	440,184		
Penalty Allowance Deduction	0		
<b>Banked Allowances</b>	<b>3,449,331</b>	Held by Affected Facility Accounts	<b>2,618,665</b>
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	<b>830,666</b>
<b>CSAPR NO<sub>x</sub> Annual Program Compliance Results</b>			
Reported Emissions (tons)	440,051		
Rounding and compliance issues (tons)	133		
Emissions not covered by allowances (tons)	0		
Total allowances deducted for emissions	440,184		

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.

Source: EPA, 2022

### Figure 4. CSAPR NO<sub>x</sub> Annual Program Allowance Reconciliation Summary, 2021

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.



CSAPR NO<sub>x</sub> Ozone Season Group 1 Program Allowance Reconciliation Summary, 2021

<b>Total Allowances Held (2015-2021 Vintage)</b>	<b>112,024</b>	Held by Affected Facility Accounts	<b>49,727</b>
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	<b>62,297</b>
Allowances Deducted for CSAPR NO <sub>x</sub> Ozone Season Group 1 Program	6,154		
Penalty Allowance Deduction	0		
<b>Banked Allowances</b>	<b>105,870</b>	Held by Affected Facility Accounts	<b>43,573</b>
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	<b>62,297</b>
<b>CSAPR NO<sub>x</sub> Ozone Season Group 1 Program Compliance Results</b>			
Reported Emissions (tons)	6,150		
Rounding and compliance issues (tons)	4		
Emissions not covered by allowances (tons)	0		
Total allowances deducted for emissions	6,154		

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.

Source: EPA, 2022

**Figure 5. CSAPR NO<sub>x</sub> Ozone Season Program Group 1 Allowance Reconciliation Summary, 2021**

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.

## 2021 Power Sector Programs – Progress Report

[https://www3.epa.gov/airmarkets/progress/reports/program\\_compliance.html](https://www3.epa.gov/airmarkets/progress/reports/program_compliance.html)



### CSAPR NO<sub>x</sub> Ozone Season Group 2 Program Allowance Reconciliation Summary, 2021

<b>Total Allowances Held (2017-2021 Vintage)</b>	<b>279,237</b>	Held by Affected Facility Accounts	<b>217,834</b>
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	<b>61,403</b>
Allowances Deducted for CSAPR NO <sub>x</sub> Ozone Season Group 2 Program	121,877		
Penalty Allowance Deduction	0		

<b>Banked Allowances</b>	<b>157,360</b>	Held by Affected Facility Accounts	<b>95,957</b>
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	<b>61,403</b>

#### CSAPR NO<sub>x</sub> Ozone Season Group 2 Program Compliance Results

Reported Emissions (tons)	121,838
Rounding and compliance issues (tons)	39
Emissions not covered by allowances (tons)	0
Total allowances deducted for emissions	121,877

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.

Source: EPA, 2022

### Figure 6. CSAPR NO<sub>x</sub> Ozone Season Program Group 2 Allowance Reconciliation Summary, 2021

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.



CSAPR NO<sub>x</sub> Ozone Season Group 3 Program Allowance Reconciliation Summary, 2021

<b>Total Allowances Held (2021 Vintage)</b>	<b>143,837</b>	Held by Affected Facility Accounts	<b>140,108</b>
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	<b>3,729</b>
Allowances Deducted for CSAPR NO <sub>x</sub> Ozone Season Group 3 Program	114,337		
Penalty Allowance Deduction	0		

<b>Banked Allowances</b>	<b>29,500</b>	Held by Affected Facility Accounts	<b>25,771</b>
		Held by Other Accounts (General, State Holding, and Non-Affected Facility Accounts)	<b>3,729</b>

**CSAPR NO<sub>x</sub> Ozone Season Group 3 Program Compliance Results**

Reported Emissions (tons)	114,293
Rounding and compliance issues (tons)	44
Emissions not covered by allowances (tons)	0
Total allowances deducted for emissions	114,337

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.

Source: EPA, 2022

**Figure 7. CSAPR NO<sub>x</sub> Ozone Season Program Group 3 Allowance Reconciliation Summary, 2021**

Notes:

- Compliance emissions data may vary from other report sections as a result of variation in rounding conventions or allowance compliance issues at certain units.
- Reconciliation and compliance data are current as of May 2022 and subsequent allowance deduction adjustments and penalties are not reflected.



## Chapter 6: Market Activity

Emissions trading programs allow participants to independently determine their best compliance strategy. Participants that reduce their emissions below the number of allowances they hold may trade allowances, sell them, or bank them for use in future years. While the Acid Rain Program (ARP) and the Cross-State Air Pollution Rule (CSAPR)<sup>1</sup> are emissions trading programs, Mercury and Air Toxics Standard (MATS) is not a market-based program; therefore, this section does not discuss MATS.

### Highlights

#### Transaction Types and Volumes

- In 2021, more than 550,000 allowances were traded across all six of the CSAPR trading programs.
- Thirty-six percent of the transactions within the CSAPR programs were between distinct organizations.
- In 2021, over 3 million ARP allowances were traded.
- Twenty-six percent of the transactions within the ARP were between distinct organizations.

#### 2021 Allowance Prices<sup>2</sup>

- The ARP SO<sub>2</sub> allowance prices averaged less than \$1 per ton in 2021.
- The CSAPR SO<sub>2</sub> Group 1 allowance prices started and ended 2021 at \$1.56 per ton.
- The CSAPR SO<sub>2</sub> Group 2 allowance prices started and ended 2021 at \$2.31 per ton.
- The CSAPR NO<sub>x</sub> annual program allowances started 2021 at \$2.00 per ton and ended 2021 at \$2.50 per ton.
- The CSAPR NO<sub>x</sub> ozone season Group 1 program allowances started 2021 at \$2.00 per ton and ended 2021 at \$2.50 per ton.
- The CSAPR NO<sub>x</sub> ozone season Group 2 program allowances started 2021 at \$200 per ton and ended 2021 at \$166 per ton.<sup>3</sup>
- The CSAPR NO<sub>x</sub> ozone season Group 3 program allowances started in March 2021 at \$3,000 per ton and ended 2021 at \$3,175 per ton.<sup>4</sup>

<sup>1</sup> CSAPR refers to the CSAPR, the CSAPR Update, and the Revised CSAPR Update programs.

<sup>2</sup> Allowance prices as reported by S&P Global Market Intelligence, 2022.

<sup>3</sup> The CSAPR NO<sub>x</sub> Ozone Season Group 2 program was established by the CSAPR Update in October 2016. The program originally covered 22 states, and currently covers 10 states, including Alabama, Arkansas, Iowa, Kansas, Mississippi, Missouri, Oklahoma, Tennessee, Texas, and Wisconsin.

<sup>4</sup> The CSAPR NO<sub>x</sub> Ozone Season Group 3 program was established under the Revised CSAPR Update in April 2021 and covers 12 states, including Illinois, Indiana, Kentucky, Louisiana, Maryland, Michigan, New Jersey, New York, Ohio, Pennsylvania, Virginia, and West Virginia.



## Background Information

### Transaction Types

Allowance transfers are the movement of allowances between allowance holding accounts. There are generally two types of transfers, those initiated by the EPA 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 set-asides. Private transactions include all transfers initiated by authorized account representatives for any compliance or general account purposes. The market activity analysis is based on private transactions.

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

- Transfers between separate and unrelated parties (distinct organizations), which may include companies with contractual relationships (such as power purchase agreements) but excludes parent-subsidiary types of relationships.
- Transfers within a company or between related entities (e.g., holding company transfers between a facility compliance account and any account held by a company with an ownership interest in the facility).

While all transactions are important to proper market operation, EPA follows trends in transactions between distinct economic entities with particular interest. These transactions represent an actual exchange of assets between unaffiliated participants, which reflect companies making the most of the cost-minimizing flexibility of emission trading programs. Companies accomplish this by finding the cheapest emission reductions not only among their own generating assets, but across the entire marketplace of power generators.

### Allowance Markets

The 2021 emissions were below emission budgets for the ARP and for all six CSAPR programs. As a result, the allowance prices for most of the CSAPR programs were well below the marginal cost for reductions projected at the time of the final rule, and are subject, in part, to downward pressure from the [available banks of allowances](#).

## More Information

- Allowance Markets <https://www.epa.gov/airmarkets/allowance-markets>
- Air Markets Business Center <https://www.epa.gov/airmarkets/business-center>
- Clean Air Markets Program Data (CAMPD) <https://campd.epa.gov>
- Emissions Trading <https://www.epa.gov/emissions-trading-resources>





## Figures

2021 Allowance Transfers under CSAPR and ARP

	Transactions Conducted	Allowances Transferred	Share of Program's Allowances Transferred	
			Related (%)	Distinct (%)
ARP SO <sub>2</sub>	517	3,113,196	40%	60%
CSAPR SO <sub>2</sub> Group 1	169	201,086	68%	32%
CSAPR SO <sub>2</sub> Group 2	45	84,085	90%	10%
CSAPR NO <sub>x</sub> Annual	341	96,831	78%	22%
CSAPR NO <sub>x</sub> Ozone Season Group 1	28	4,248	99%	1%
CSAPR NO <sub>x</sub> Ozone Season Group 2	914	165,068	57%	43%
CSAPR NO <sub>x</sub> Ozone Season Group 3	109	9,923	49%	51%

Notes:

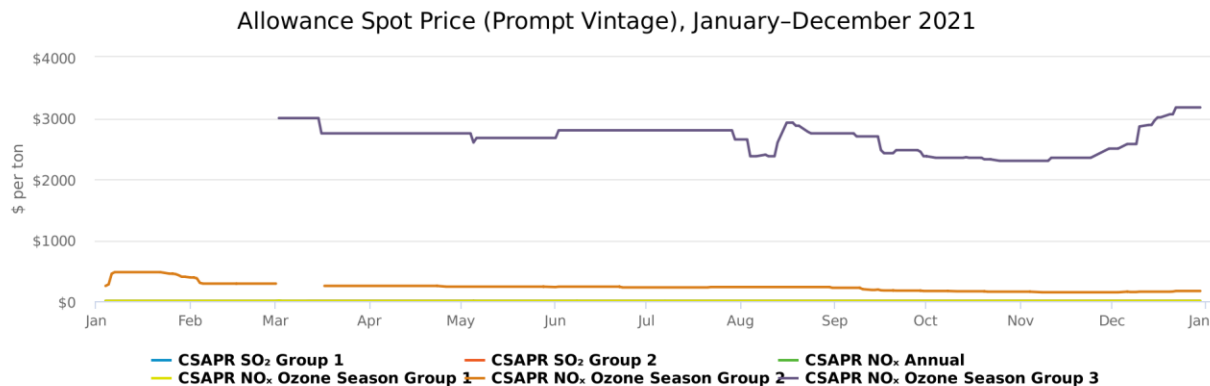
- The breakout between distinct and related organizations is not an exact value as relationships are often difficult to categorize in a simple bifurcated manner. EPA's analysis is conservative and the "Distinct Organizations" percentage is likely higher.
- Percentages may not add up to 100% due to rounding.

Source: EPA, 2022  
Last updated: 05/2022

**Figure 1. 2021 Allowance Transfers under CSAPR and ARP**

Notes:

- The breakout between distinct and related organizations is not an exact value as relationships are often difficult to categorize in a simple bifurcated manner. EPA's analysis is conservative and the "Distinct Organizations" percentage is likely higher.
- Percentages may not add up to 100% due to rounding.



Notes:

- Prompt vintage is the vintage for the "current" compliance year.
- The CSAPR Update Rule, published October 2016, created two geographically distinct state trading groups: Group 1, comprised only of Georgia, and Group 2, originally comprised of 22 states. The Revised CSAPR Update, published April 2021, created a third trading group, moving 12 states from Group 2 to Group 3. The allowance prices for Group 1, Group 2, and Group 3 are shown.
- There is a small value for the allowance price for "CSAPR SO<sub>2</sub> Group 1", "CSAPR SO<sub>2</sub> Group 2", "CSAPR NO<sub>x</sub> Annual", and "CSAPR NO<sub>x</sub> Ozone Season Group 1". The data for these items is not easily visible on the full chart. To more clearly see the allowance price for these items, use the interactive features of the figure: click on the lines in the legend to turn off the purple and orange categories (labeled "CSAPR NO<sub>x</sub> Ozone Season Group 2" and "CSAPR NO<sub>x</sub> Ozone Season Group 3") and keep all of the other legend items on.

Source: S&P Global Market Intelligence, 2022

**Figure 2. Allowance Spot Price (Prompt Vintage), January–December 2021**

Notes:

- Prompt vintage is the vintage for the "current" compliance year.
- The CSAPR Update Rule, published October 2016, created two geographically distinct state trading groups: Group 1, comprised only of Georgia, and Group 2, originally comprised of 22 states. The Revised CSAPR Update, published April 2021, created a third trading group, moving 12 states from Group 2 to Group 3. The allowance prices for Group 1, Group 2, and Group 3 are shown.
- There is a small value for the allowance price for "CSAPR SO<sub>2</sub> Group 1", "CSAPR SO<sub>2</sub> Group 2", "CSAPR NO<sub>x</sub> Annual", and "CSAPR NO<sub>x</sub> Ozone Season Group 1". The data for these items is not easily visible on the full chart. To more clearly see the allowance price for these items, use the interactive features of the figure: click on the lines in the legend to turn off the purple and orange categories (labeled "CSAPR NO<sub>x</sub> Ozone Season Group 2" and "CSAPR NO<sub>x</sub> Ozone Season Group 3") and keep all of the other legend items on.