

Acid Rain: The EPA's Approach to Water Pollution

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Introduction

The United States government's approach to addressing acid rain has evolved over the past several decades, with the implementation of new methods for tracking emissions and targeting polluters. The government's response to acid rain before 1990 was to place responsibility on individual citizens without regulating the power sector, which is the source of most acid rain-causing pollutants. With the Title IV amendment to the Clean Air Act (also known as the Acid Rain Program) in 1990, the power industry began to face stricter regulations.¹ The US Environmental Protection Agency (EPA) started tracking emissions of SO₂ and NO_x using the Clean Air Status and Trends Network (CASTNET) system in 1991.² Although commercial emitters are the primary source of these pollutants, CASTNET only measures non point source pollutants, effectively ignoring commercial sources that originate these pollutants.

Many government publications also fail to reflect the actual major drivers of environmental degradation, instead focusing on the need for individual citizens to contribute to the solution. *Learning About Acid Rain*, a middle-school guide, recommends that students turn off lights when not in use, use alternate forms of transportation, and reduce emissions by lowering their thermostat in the winter.³ While the government's approach has aimed at increasing individual energy saving, the Acid Rain Program (ARP) has been effective at lowering emissions from the power sector. ARP's market-based regulations in the 1990s included limited authorizations to emit, resulting in a 16.3-million-ton reduction in SO₂ emissions by 2021.⁴ As of November 2024, the ARP is up for public comment before it is renewed.⁵ This comment period is an opportunity to discuss critical legislation regarding corporate emissions and the landscape of climate change, responsibility, and agency.

Problems and Early Solutions

Acid rain is a phenomenon that occurs when sulfur dioxide (SO₂) and nitrogen oxides (NO_x) are emitted into the

atmosphere. They create sulfuric and nitric acid when combined with water.⁶ Natural events, such as volcanic eruptions or wildfires, can cause acid rain. Still, it is also a significant hallmark of anthropogenic environmental degradation caused by "burning fossil fuels, manufacturing, oil refineries, electricity generation, and vehicles."⁷ Power plants are one of the most significant anthropogenic contributors to acid rain. When fossil fuels are burned in large quantities to generate electricity, emissions that cause acid rain are intensified and can lead to severe degradation of local ecosystems.

In the 1950s, scientists began to document the devastating impacts of acid rain on ecosystems in the United States. Lakes and soil are particularly vulnerable to the effects of acid rain, which can last for many decades after an initial disturbance. The sulfuric and nitric acids found in acid rain lower the pH of soil and water, which can lead to wildlife and plant die-offs, as well as drastic ecosystem changes. In the 1960s, one of the worst cases of acid deposition and subsequent environmental degradation drew public attention in the United States. The Adirondack and Catskill mountain ranges experienced both tree and aquatic life die-offs due to acidic soils and water systems.⁸ Local programs, such as the Adirondack Long Term Monitoring Program and New York's Acid Deposition Monitoring Network, as well as large-scale federal programs like the Acid Rain Program and the CASTNET Monitoring Program, have contributed to improving these conditions.⁹ However, these ecosystems have not yet fully recovered from this disturbance and are likely to remain negatively impacted for years to come.¹⁰

Corporate Regulation

The impact in the Adirondack and Catskill mountain ranges prompted concerned citizens, scientists, and policymakers to pursue legislative action during the mid-20th century and beyond. Although this is one of the most egregious examples, acid rain negatively impacted most of the United States and disrupted vast swaths of natural land. Because rain is not confined

to a specific geographic area, pollution from one location can be transported by wind currents many miles to a new location. Acid rain crosses state lines, tribal nations, and socioeconomic boundaries. It has adverse impacts in both rural and urban areas, as it can erode manufactured structures in cities and cause issues with heart function (including heart attacks) and worsen lung function in humans, particularly for people who already have pre existing medical conditions.¹¹

These factors ultimately pushed the federal government to become increasingly involved in regulating the power industry. Acid rain is a product of both air and water pollution, and as such, air pollution was first federally legislated by inclusion in the Water Pollution Act of 1955.¹² As Forest Service researchers at New Hampshire's Hubbard Brook and scientific centers across America began to identify the depth and severity of the acid rain problem, public and academic concern spurred Congress to pass the Clean Air Act of 1963. This act established funding and legislative justification for increased federal oversight of air pollution.¹³ However, it soon became apparent that amendments to this act were necessary to promote efficiency and reduce emissions. In 1970, President Nixon authorized the organization of the EPA, which holds the authority to set state and tribal pollution compliance standards. The initial organization plan included an Air Pollution Control Office, tasked with "the achievement of a wholesome air environment through development of air pollution control technology."¹⁴ The same year saw amendments to the Clean Air Act, which set future reduction goals and significantly strengthened the government's ability to enforce regulations. Acid rain was not the only environmental hazard targeted by the EPA's Clean Air Act programs; particle pollution, carbon monoxide, ground-level ozone, and lead are also tracked, regulated, and reduced through the policies and programs established by the Clean Air Act.¹⁵

This act laid the groundwork for subsequent amendments in the 1990s that established the CASTNET monitoring system.¹⁶ CASTNET sites across America measure point pollution (pollutant aggregations) to track anthropogenic and natural pollution levels and assess the progress of emission reduction programs. One major reduction program is the ARP, which operates a "cap-and-trade" system founded on private, free market principles. The ARP required major emitters to reduce emissions to half the levels of 1980. This program targeted the power sector, which is responsible for nearly 70 percent of SO₂ and 40 percent of NO_x emissions in the United States.¹⁷ The majority of the power sector is owned and operated by "192 Investor-Owned Utilities (IOUs) [who] account for a significant portion of net generation (38%), transmission (80%), and distribution (50%)."¹⁸ To enforce and incentivize reduction strategies of these utility companies that

operate power plants, the EPA initiated an allowance market. After setting a cap on the total amount of allowable pollution, the EPA created a certain number of allowances (permits to pollute) that are available to anyone—a private citizen, independent power company, or traditional utility. These allowances are partially allocated to existing utilities, and the remainder is sold directly or through an auction. If an allowances owner does not use all their allowances, they can sell, trade, or store them for later use.¹⁹ This enables an efficient and cost-effective method of distributing permits without overextending the EPA's resources.

One allowance is worth one ton of released SO₂. The cap-and-trade program sells allowances based on SO₂, as most NO_x emissions originate from motor vehicles. The EPA sets requirements for vehicle manufacturers, including smog tests and gasoline refinement, and requires utilities to provide data on both their SO₂ and NO_x emissions.²⁰ From the start of these programs in 1991 to the present, it's clear that the ARP and the Clean Air Act have been highly effective in reducing SO₂ and NO_x emissions in the United States. Progress reports from the power sector for 2021 have recorded full compliance with ARP and an overall 94 percent reduction in SO₂ emissions from 1990 levels, as well as an 85 percent reduction in NO_x emissions from 2000 levels. The Eastern US environment, home to the Adirondack and Catskill mountains, has demonstrated considerable recovery in the past twenty years, with wet sulfate deposition down by 71 percent.²¹

Although there have been regulatory advances in the past few decades to hold corporations more accountable for their pollution, this is an ongoing battle. The ARP, which was open to public comment and renewal in November 2024, establishes federal regulations that require compliance by utilities and other major emitters.²² The program "sets a permanent cap on the total amount of SO₂ that may be emitted by electric generating units (EGUs) in the contiguous United States." In contrast, the NO_x program "applies to a subset of coal-fired EGUs and is closer to a traditional, rate-based regulatory system."²³ The ARP, administered by the EPA, regulates the power sector's allowable emissions. It has been effective in reducing emissions as opposed to previous weaker regulations but still allows corporations to pollute the atmosphere by buying permits to emit pollutants.

Messaging Pushing for Individual Responsibility

Targeting traditional and independent power utilities via the allowances market and establishing federal caps on allowable emissions has made the most difference in pollution reduction. However, even within these programs targeting major emitters, consumers and private citizens are still held responsible for a considerable amount of pollution. The ARP awards bonus

allowances to utilities that “encourag[e] energy conservation by customers so that less power needs to be produced.”²⁴ Throughout public-facing government documents intended to educate Americans about acid rain and pollution emissions, narratives emphasizing individual responsibility and agency are present. The EPA’s 1991 press release regarding the Clean Air Act, “New EPA Rule Gives Every American Right to Buy and Sell Acid Rain Emissions,” emphasizes both the free market aspect of the allowances program and the individual roles in regulating acid rain.²⁵

The EPA’s *Plain English Guide to the Clean Air Act* directs citizens to drive less often, burn less wood, buy energy-saving appliances, plant deciduous trees to keep houses cool, wash clothing with cold water, buy rechargeable batteries, refill the gas in your car during the evenings, and recycle, and it also explains the policies and history of the ARP.²⁶ While this advice is essential, and individual citizens should understand their role in pollution and do what they can to reduce their impact, the role that large utility companies play is often understated in public communication. The EPA encourages contacting state and local departments for more information. Still, this guide underemphasizes both citizens’ ability to hold their utility companies and representatives accountable for pollution and the relative lack of influence citizens have regarding pollution. Power sector legislation and regulation have proven successful and effective in reducing SO₂ and NO_x because they target the pollution source—power plants—and not the consumers of under regulated products.

Communications with the public have not followed a similar pattern of change in response to regulation. In fact, the message to the public has remained relatively stagnant as the acid rain problem and subsequent regulations have fluctuated. A 1990 publication from the EPA titled *Acid Rain: A Student’s First Sourcebook* offers this solution for individuals wanting to make a difference:

Each person who turns off lights when no one is using them and uses energy-saving appliances reduces the amount of energy a power plant needs to produce. When less power needs to be produced, pollution from power plants decreases. Car-pooling, using public transportation, and walking reduce the pollutants that come from vehicles. The sum total of all of these individual actions can be very great indeed.²⁷

The book also discusses the root causes of acid rain (mainly the burning of fossil fuels). It has sections on research being conducted and addresses the need for installing scrubbers on power plants’ smokestacks and transitioning to alternative energy production.

This source does not ignore the cause of the problem but suggests that the actions of individual people are a significant part of the issue, rather than the systemic biases toward fossil fuel energy production that contribute to acid rain.

This messaging to the public has stayed relatively consistent throughout regulation changes. *Learning About Acid Rain: A Teacher’s Guide for Grades 6 Through 8* is a 2008 publication from Clean Air Market Programs (a division of the EPA) and is intended for in-classroom learning. It covers the scientific reasons for acid rain, as well as the negative environmental consequences. The publication also includes a section on what individuals can do to address the issue, recommending that students turn off lights when not in use, use alternative forms of transportation, and lower their thermostat in the winter to reduce emissions.²⁸ Although these are not harmful suggestions, they fail to address the root of the issue, like the other EPA-produced student guide from eighteen years earlier.

Effectiveness and Implications for Environmental Justice

Regulations and emissions levels have changed. Although the acid rain issue is not entirely solved, some progress has been made. This progress, however, has not been reflected in public messaging over the last several decades. Individual responsibility is essential, but the problem does not seem to be a lack of awareness but rather a lack of ability to effect significant systemic changes in the energy production landscape. The present landscape of pollution emission and climate change remains rocky. Researchers continue to develop methods for revitalizing forests, soils, and lakes to improve affected environments. Hubbard Brook scientists have experimented with the “effects of adding calcium back to the soil. At study sites within Hubbard Brook, trees such as Sugar Maple have displayed significant improvements in health after calcium reapplication. These trees exhibit larger, healthier leaves, increased water use—known as evapotranspiration—and less winter injury.”²⁹ Increasing funding for and awareness of climate science initiatives and programs is essential in our fight toward a healthier and more resilient natural environment.

The ARP has proven effective at forcing utility companies to reduce their emissions. However, addressing and resolving pollution issues in the United States, which directly contribute to anthropogenic climate change and global warming, cannot stop there. The EPA’s approach to acid rain through the ARP can be adapted by other programs within the EPA and related agencies to combat corporate sources of emissions. Citizens need access to information on the major polluters and the legal avenues for increasing emission restrictions. When discussing individuals’

responsibilities, agencies must recognize that citizens across the United States have unequal levels of power and agency based on their race, gender, and socioeconomic status. People may not be able to afford energy-efficient products or swaps or lack access to cleaner options, such as those living in counties and states without robust public transportation. Those who lack the privilege to exercise agency in these matters are also often the ones hurt most by environmental degradation. According to the EPA's 2021 Power Sector Progress Report, "program evaluation through an environmental justice lens shows more disadvantaged people living near power plants with higher emissions."³⁰ The ARP's success provides evidence that targeting major emitters, setting caps on the total allowable amount of emissions, and strictly enforcing these regulations can work. Protecting the EPA's regulatory authority, monitoring utility companies' activities, and continually striving for further emissions reductions are more necessary now than ever, as the climate crisis wreaks havoc on our communities, environments, and homes.

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Notes

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