The 50th Anniversary of the Clean Air Act

DRAFT REPORT

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Introduction

In 1970, Congress established the Environmental Protection Agency (EPA) and passed the modern Clean Air Act (CAA). Universally considered to be one of the most impactful and comprehensive federal laws, in its pervasive effect on health and the economy, the CAA and its subsequent amendments, put into place a wide range of regulatory programs created specifically to improve the quality of the nation's air and to promote substantial economic growth and innovation.

Since the passage of the CAA, the combined emissions of six criteria pollutants (particulate matter, sulfur dioxide, nitrogen oxides, volatile organic compounds, carbon monoxide, and lead), also known as criteria pollutants, have decreased by 74% across the United States. Emissions of toxic pollutants, such as mercury, have decreased significantly as well. Notably, these improvements occurred as the economy grew markedly and energy use and vehicle miles increased.

The CAA requires EPA to set health-based standards for ambient air quality, sets deadlines for the achievement of the standards by state and local governments, requires EPA to set national emission standards for sources of air pollution (e.g., motor vehicles, power plants, industrial sources), mandates emission controls for 187 hazardous air pollutants, imposes a cap-and-trade program to address acid rain, requires the prevention of significant deterioration of air quality in areas with clean air, requires a regional haze program to restore visibility in national parks and wilderness area, imposes an operating permit program for major sources, implements the Montreal Protocol to phase out most stratospheric ozone-depleting chemicals. These hallmarks of the CAA, among other relevant topics, are discussed within this report.

The CAA is one of the most important pieces of public health legislation ever adopted in the US, as it has demonstrably helped protect the health of the citizens of the United States. In the last fifty years, researchers have identified a range of physiological pathways by which air pollution impacts the body, from inducing inflammation, to triggering arrhythmias, promoting atherosclerosis,[1] suppressing the immune system,[2] and contributing to cognitive impairment and dementia.[3] [4] Epidemiologists have demonstrated that each 1-ug/m3 increase in fine PM associated with a 9.31% increase in hospital visits and admissions. Globally, exposure to PM2.5 is recognized as the 5th highest mortality risk factor.[5] In the US, however, the successes of the CAA have reduced premature deaths, reduced prevalence of certain diseases, such as asthma, lowered medical expenses and school absences and increased worker productivity.[6]

One of the greatest achievements of the CAA is the involvement of the public in its implementation. The CAA and the Administrative Procedure Act are intended to ensure that the viewpoints of the public, which consist of the full and diverse range of stakeholders (including regulated entities) impacted by EPA's actions under the statute, are considered as directed by Congress. EPA should continue to strive to increase accessibility to and transparency of participation and engagement in rulemaking and other processes under the statute, as appropriate.

The CAA also represents a regulatory approach based on cooperative federalism, in which local air quality issues and the policy tradeoffs that come with them are managed largely at the local level by state and local agencies, as well as tribal authorities. In general, EPA sets the regulatory framework, but those closest to the issues make the decisions on how to achieve the statutory goals.

The successes of the CAA are numerous and are highlighted in this report. Overall, air quality has dramatically improved over the past 30 years, which is attributable not only to the Clean Air Act but also to the innovation and effort of people. Those people include those who work in the government (federal, state, tribal), in companies, in non-governmental organizations, and as private citizens. Emissions of all pollutants have been dramatically reduced. Nonetheless, as our scientific knowledge and social awareness improve, we find that additional work remains to be done to achieve the twin goals of the statute (protecting and enhancing the nation's air quality and the productive capacity of the population). To that end, this report addresses the successes as well as the challenges and opportunities of implementing the CAA and offers going-forward suggestions for EPA's consideration.

Report Methodology

The CAA 50th Anniversary Report Committee began meeting in September 2020 to review the charge from EPA and create a plan to draft this report. The report is intended to represent the range of CAAAC experience, expertise, and views, in an effort to ensure the CAAAC had opportunities to provide input to the process and the report itself.

While the report committee's expertise gave solid insight into successes, it decided to develop a survey and written template for CAAAC members to submit their views on challenges. This process led to the development of the report outline, which the report committee has been utilized in development of this document.

A draft of the outline was shared with the CAAAC during the December 2020 committee meeting. After a full briefing of the draft outline, CAAAC members were invited to virtual breakout rooms to share feedback on the outline, including important concepts, challenges, and recommendations for the report.

The report committee split portions of the report into sections, assigning a lead writer and small writing committee. The group met frequently via videoconference to gather feedback on sections, especially to develop consensus viewpoints and developed joint drafts of each section.

While care was taken to separate the report into discrete sections, it is noteworthy that the themes underlying many of the issues and challenges repeat in each section of this report. For example, environmental justice, which has its own section, could be included in any of the sections of the report. Additionally, the charge did not indicate suggestions that would require legislative change, so the recommendations made within this report are intended to be workable within the current framework of the CAA.

The report committee represents diverse viewpoints and expertise. The recommendations expressed in this document are not necessarily those of any individual committee member or the clients, customers, and stakeholders they serve and they should not be interpreted or represented as such.

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Attainment and Maintenance of the National Ambient Air Quality Standards

Overview

One of the signal achievements of the Clean Air Act is the creation and attainment of National Ambient Air Quality Standards (NAAQS) for six common pollutants – carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2), known as the "criteria" air pollutants. By establishing limits on ambient air pollution and a regulatory framework for attaining and maintaining them through State Implementation Plans (SIPs), Tribal Implementation Plans (TIPs), and Federal Implementation Plans (FIPs), the Clean Air Act has led to dramatic improvements in public health and welfare.

- Under Title I of the 1970 Clean Air Act, EPA established the first set of NAAQS in April 1971
- Following the promulgation of the first NAAQS, states submitted the first set of SIPs to attain and maintain the NAAQS within their jurisdictions, and to avoid contributing to violations of the NAAQS in other states. EPA also began issuing new source performance standards (NSPS) to help reduce emissions from new sources.
- The 1977 Clean Air Act Amendments established a new framework for addressing persistent violations of the NAAQS by designating such areas (and nearby areas contributing to the violations) as "nonattainment" and mandating special regulations be incorporated into the SIPs for these areas.
- The 1977 Amendments also required EPA to review the NAAQS at five-year intervals starting in 1980, and to consult with an independent advisory committee that came to be known as the Clean Air Scientific Advisory Committee (CASAC) in conducting these reviews.
- The 1990 Clean Air Act Amendments further addressed persistent violations of the NAAQS by creating pollution-specific classifications and SIP requirements and a system for "bumping up" an area's classification and regulatory requirements if it failed to attain the NAAQS on-time.

Successes

1. **Criteria pollutant reductions**: There have been significant reductions in emissions of all criteria pollutants and precursors, which has led to substantial improvements in ambient air quality, particularly since 1990:[7]

Table 1. Reductions in Criteria Pollution Emissions and Concentrations

Pollutant	Timeframe	Precursor Emission Reductions	Average Ambient Concentrations
CO	1990-2020	99.8 million tpy CO (69%)	78% reduction in peak 8-hour CO
NO_2	1990-2020	17.2 million tpy NO_X (68%)	58% reduction in annual NO_2 48% reduction in peak 1-hour NO_2
O_3	1990-2020	17.2 million tpy NO_X (68%) 11.1 million tpy VOC (48%)	26% reduction in peak 8-hour O_3

Pollutant	Timeframe	Precursor Emission Reductions	Average Ambient Concentrations
Pb[8]	2010-2020	0.283 thousand tpy Pb (30%)	78% decrease in peak 3-month Pb
PM_{10}	1990-2020	1.0 million tpy PM_{10} (31%)	38% decrease in peak 24-hour PM_{10}
$PM_{2.5}$	2000-2010	1.1 million tpy $PM_{2.5}$ (42%) 14.3 million tpy NO_X (64%) 14.5 million tpy SO_2 (89%) 4.9 million tpy VOC (29%)	45% decrease in annual PM2.5 44% reduction in peak 24-hour $PM_{2.5}$
SO_2	1990-2020	2.31 million tpy SO_2 (92%)	94% reduction in peak 1-hour SO_2

2. **Poor Air Quality Days**: the average number of days when O_3 or $PM_{2.5}$ air pollution reached levels considered "unhealthy for sensitive groups" across 35 major U.S. cities decreased from 59 in 1990 to 18 in 2020.[9]

3. Attaining NAAQS

   3.1. **Almost all areas of the country are attaining the CO and NO_2 NAAQS**: In 2019, all areas of the country were in compliance with all CO and NO_2 NAAQS, and in 2020, all areas of the country were in compliance with the 1-hour CO NAAQS, the 1-hour NO2 NAAQS, and the annual NO_2 NAAQS, and only one area was violating the 8-hour CO NAAQS.

   3.2. **Progress in attaining the other NAAQS**: Emission reductions in nonattainment areas and across the country have helped achieve significant progress in allowing O_3, $PM_{2.5}$, PM_{10}, Pb, and SO_2 nonattainment areas attain these NAAQS, enabling a number of communities get redesignated to "attainment."

   3.3. **Fewer nonattainment areas:** Even as the NAAQS have gotten tighter, the number of areas designated nonattainment has significantly shrunk, particularly after the 1990 Clean Air Act Amendments. This enables many more communities to more extensively pursue their economic development goals and efficiently conduct transportation planning.

4. **Frameworks for addressing air pollution transported over state and international borders**: The Clean Air Act and EPA have established a framework for addressing interstate air pollution, helping states and local governments with air pollution problems accelerate the attainment of the NAAQS and improving equity across states in reducing emissions needed to ensure attainment and maintenance of the NAAQS. These included Section 126 petitions, the O_3 transport commission in the northeast, the NO_X SIP call, the Cross State Air Pollution Rule (CSAPR) and subsequent updates and guidance on Transport SIPs using the CSAPR framework. Section 179B of the Clean Air Act also provides a mechanism for areas significantly impacted by pollution from other countries to reduce the regulatory burden associated with a nonattainment designation while still ensuring some basic local pollution controls are in place as well.

5. **Pollution controls for nonattainment areas:** Pollution control requirements for nonattainment areas, including Nonattainment New Source Review permitting, Reasonably Available Control Technology, Reasonably Available Control Measures, Reasonable Further Progress, Inspection and

Maintenance programs, and conformity have been important in enabling areas to attain the NAAQS as "expeditiously as practicable."

6. **Proactive programs to assure continued attainment of the NAAQS**: Since 1995, EPA has created programs to support voluntary local efforts to reduce air pollution levels and stay in compliance with the NAAQS for "near-nonattainment" areas and better position themselves for coming into compliance with the NAAQS quickly if they do violate them. These have included the Flexible Attainment Region program in 1995, the 1-Hour O_3 Flex Program in 2002, the Early Action Compact Program from 2002 – 2007, the 8-Hour O_3 Flex Program in 2006, the O_3 Advance Program in 2012, and the PM Advance Program in 2013.

7. **Improved understanding of air pollution:** The Clean Air Act's provisions requiring regular reviews of the NAAQS with input from an independent scientific advisory committee have also led to a total of 44 reviews of the primary and secondary NAAQS, significant improvements the scientific understanding of air pollution over the years. These reviews have enabled EPA, states, local governments, and tribes to better target their pollution control efforts in ways that achieve greater health protections more efficiently.

Opportunities

1. **Mobile sources**: EPA's mobile source emissions and fuels standards are projected to continue to achieve significant emission reductions in the future even with continued growth in vehicle activity and equipment use. These nation-wide programs will go a long way to helping areas attain and maintain the NAAQS.

2. **Stationary sources** : There are opportunities for additional emission reductions from stationary sources in many parts of the country. These could be achieved as a result of the Cross-State Air Pollution Rule (CSAPR) or other interstate transport SIPs, new source performance standards, RACT/RACM rules, NSR permitting, significant in-use cases of new technology, and the reduced cost of natural gas and renewable energy relative to coal are also expected to yield significant reductions in criteria pollutant concentrations across the country.

3. **EPA's completion of reviews of both the O_3 and PM NAAQS in late 2020:** This may enable EPA to coordinate the next reviews of these NAAQS due in 2025 and provides some time for the SIP process to work as initially envisioned. The review of the O_3 NAAQS within the statutory 5-year time frame and the acceleration of the completion of the PM NAAQS review also provide concrete examples of changes in the process of conducting a NAAQS review to meet deadlines that EPA can use to help inform future NAAQS reviews for these and other pollutants.

4. **Lesser-used provisions in the Clean Air Act**: There are lesser-used provisions in the Clean Air Act that may be available to better tailor solutions for the wide range of situations communities face with attaining and maintaining the NAAQS. These include its authority to approve or disapprove "infrastructure" SIPs and issue "SIP calls" under Section 110, the more general nonattainment provisions of section 172 of the Clean Air Act (i.e., Title I, Part D, Subpart 1), and Section 179B petitions related to international pollution transport.

5. **Improvements in air quality forecasting and public awareness about current air quality**: Forecasting and public awareness can help areas and the public take more targeted actions to

reduce emissions on predicted high-pollution days and help members of the public limit their exposure to high pollution when it occurs.

6. **Sensor technology**: The widespread availability of low-cost sensors can significantly expand understanding of criteria air pollution across the country and can help inform EPA's requirements for the siting of regulatory monitors in the future.

Future Challenges

1. **Many people live in areas violating the NAAQS:** In 2020, 96 million Americans lived in a county that is violating a NAAQS, almost all of whom live in an area violating either the O_3 or PM NAAQS.[10] This includes a significant number of people living areas that are now violating a NAAQS for which they were previously designated "attainment/unclassifiable."

2. **Disproportionate exposure to criteria air pollution in EJ communities:** EPA's recent review of the PM NAAQS also indicates that there are clear, statistically significant racial disparities in exposure to PM air pollution, but its recommendations for consideration of an alternate NAAQS focused on "average" exposure across the country. To the extent that evidence exists of disproportionate air pollution exposure for communities of color and low-income communities, EPA's approach to reviewing, establishing, and enforcing NAAQS for these groups has not seemed to adequately address these disparities.

3. **Costs of Implementing Additional Controls:** In many areas that have already implemented stringent rules and implemented expensive programs, achieving additional emission reductions may become cost-prohibitive to certain businesses, and nonattainment designations can have major economic impacts on certain key business sectors and restrict flexibility in transportation planning.[11]

4. **Ambiguity about "out-of-cycle" nonattainment designations**. While Section 107 of the Clean Air Act is very clear about the process and timelines for designating areas nonattainment, unclassifiable, and attainment for a new or revised NAAQS, it is ambiguous on the process for an area initially classified as attainment/unclassifiable for a NAAQS that subsequently records a violation EPA has rarely if ever initiated "out-of-cycle" nonattainment designations in such situations, but this results in areas with similar pollution concentrations violating the NAAQS being treated differently. The lack of clear criteria for when it would proceed with such a redesignation creates significant uncertainty for states, local governments, tribes, businesses, and the public.[12]

5. **Issues in reviewing and establishing NAAQS:** There are a number of important unresolved issues related to reviewing and establishing the NAAQS, including the lack of clear thresholds below which harm does not occur for many pollutants, establishing secondary NAAQS distinct from the primary NAAQS, and completing NAAQS reviews within the 5-year timeframe required by the Clean Air Act. In addition, certain aspects of the NAAQS review process have received far less attention in recent years than perhaps they should have – very little consideration has been given to the proper averaging times and statistical forms for the NAAQS, relying instead on consistency with prior NAAQS reviews.

6. **Properly accounting for pollution from other countries and exceptional events:** The main purpose of the NAAQS program and nonattainment designations is to implement extra controls in areas with air pollution levels known to be unhealthy, but for regional pollutants like O_3 and $PM_{2.5}$ in particular, higher local air pollution concentrations due to international sources or exceptional

events limits the effectiveness of local emission controls at reducing ambient air pollution concentrations. While the Clean Air Act does provide EPA with mechanisms for dealing with these situations, there are still a lot of unresolved issues with their implementation, and with the exceptional events policy in particular, there are major questions remaining about the consistency in the application of this policy in different parts of the country, the extent to which events that have been considered exceptional may no longer be so (i.e., a single wildfire versus "wildfire season"), and the appropriate policies for allowing exceptional event demonstrations to exempt an area from a nonattainment designation.

7. **Tension between easing regulatory burdens from overlapping NAAQS and anti-backsliding**: There are many areas that are designated nonattainment for multiple NAAQS for the same pollutant that vary only in their level. For example, there are 35 areas that are nonattainment for both the 2008 and 2015 O_3 NAAQS. Having to plan for two different NAAQS for the same area that may have different nonattainment area boundaries for each NAAQS can create a significant regulatory burden for states, Tribes, and local governments. On the other hand, such areas will almost always have less stringent planning requirements for the more stringent NAAQS. For example, 13 of the O_3 nonattainment areas are classified as "Marginal" for the 70 ppb NAAQS but are classified as "Moderate" or higher for the 75 ppb NAAQS.

8. **Challenges with SIPs, especially for O_3**: EPA, states, local governments, and tribes continue to face challenges with SIPs, particularly for O_3. For O_3 nonattainment areas, the large number of "marginal" areas not required to submit attainment plans, the very short 3-year periods between attainment dates for different classifications, the "bump-up" process, and the dozens of regulatory requirements for areas classified as "moderate" or higher, and the VOC-focused nature of those requirements cause significant inefficiencies and delays in attaining the NAAQS. There are also a number of issues that areas classified (or formerly classified) as "Severe" for the O_3 NAAQS face related to Section 185 fees and how that provision of the Clean Air Act is applied that create some important uncertainties for states, local governments, and businesses. And while EPA has made a lot of progress in clearing the backlog of SIPs that it had not taken action on yet, there still is a backlog and deadlines for EPA to take action on SIPs are often not met. In addition, local air pollution levels of some pollutants such as O_3 and $PM_{2.5}$ are significantly impacted by factors beyond their control, including intrastate, interstate, and international air pollution, biogenic emissions, and exceptional events. Moreover, frequent litigation over the NAAQS and every aspect of their implementation creates significant uncertainty and inefficiencies in conducting good air quality planning.

9. **Challenges in public communication about attainment/violation of the NAAQS and the Air Quality Index:** There is a significant discrepancy between the way the public consumes and uses air quality data on a day-to-day basis (i.e., the Air Quality Index, or real-time, short-duration concentration data from air quality sensors) and the statistical form of the NAAQS. It can be difficult to explain to members of the public and stakeholders that an area can be in attainment of the NAAQS but still periodically exceed the level of the NAAQS.

Recommendations

1. Improve the NAAQS review process

1.1. **Reduce Uncertainty about Timing and Finality of NAAQS Reviews**: While the CAAAC recognizes the challenge of balancing the need for conducting high-quality, legally defensible NAAQS reviews with completing the reviews at five year intervals. However, we believe that EPA needs to adhere to the statutory five-year requirement. This ensures that the NAAQS are reflecting the latest scientific understanding of air pollution in a timely manner and helps reduce the pressure a new administration may feel to "reconsider" a NAAQS review decision made late in the term of the prior administration. The last such reconsideration that took place for the 2008 O_3 NAAQS ultimately just postponed both the implementation of the 2008 NAAQS and the completion of the next O_3 NAAQS that was eventually completed in 2015. To the extent that a new EPA Administrator may feel that the prior Administrator's decisions on NAAQS reviews were not protective enough, it should instead consider accelerating the next periodic NAAQS review and leverage its authority under Section 110 of the Clean Air Act to achieve additional emission reductions under the auspices of reducing interstate transport or "maintaining" the existing NAAQS.

1.2. **Synchronize NAAQS Reviews with Common Precursors:** EPA should consider synchronizing its NAAQS reviews for pollutants that share precursors (such as O_3, PM, NO_2, and SO_2) to maximize the ability to account for co-pollutant effects and the potential benefits of multi-pollutant control approaches, similar to the SO_X/NO_X/PM secondary NAAQS review currently underway.

1.3. Ensure continued accounting for the level of protection needed for EJ communities in the NAAQS review process as "sensitive" populations: Similar to the analysis conducted in the 2020 PM NAAQS review, EPA should be explicitly considering differential and cumulative exposure by race/ethnicity and income for all NAAQS reviews as part of their analysis of "sensitive" populations.

1.4. **Evaluate forms and averaging times for O_3 and PM NAAQS to Account for Weather Trends:** Given observed trends in weather conditions, EPA should conduct a more thorough review of the appropriate form and averaging times for the next O_3 and PM NAAQS reviews and should periodically conduct this kind of thorough review for each pollutant. The forms and averaging times of the O_3 and $PM_{2.5}$ NAAQS have remained the same for 24 years and the form and averaging time of the PM_{10} NAAQS has remained the same for 34 years, despite clear trends in weather conditions, including weather extremes, since then and projected into the future. While it may not be necessary or appropriate to thoroughly evaluate these elements of the NAAQS in every review, EPA should incorporate a more thorough review of these elements in the next O_3 and PM NAAQS reviews and perhaps every other review after that.

1.5. **Account for International Transport in Reviewing the NAAQS:** In assessing the appropriate level, averaging time, and statistical form of the NAAQS, EPA should take into account the extent to which long-range international transport of air pollution contributes to ambient air concentrations and the variations in these contributions over different time frames.

1.6. **Move Implementation Rules Forward in Tandem with NAAQS Reviews:** EPA should propose and finalize implementation rules for any revised NAAQS in tandem with the NAAQS revision proposal and finalization (i.e., simultaneously if possible, but if not, within months, rather than years, of the schedule for proposing and finalizing the NAAQS reviews).

2. **Make Better Use of the Full Range of Authority in the Area Designation Process:** Following a NAAQS revision, EPA should consider more extensive use of its options to extend the designation process by a year beyond the standard 2-year time frame or designate an area as "unclassifiable," especially if an area's air pollution levels are very close to the level of the NAAQS or at least one of the three years in the 3-year period covered by the NAAQS had air pollution levels that would meet the NAAQS. Outside of the initial designation period, EPA should establish clear rules or guidance in conducting "out of cycle" nonattainment designations and should carefully track the status of any area it designated as "unclassified" in the initial designations.

3. **Consider Requiring More Interstate Air Pollution Abatement:** Given the large contribution of interstate air pollution to O_3 and PM design values in nonattainment areas and "near-nonattainment" areas, EPA should require more interstate O_3 and PM air pollution from the states than is currently being achieved to further interstate air pollution. For example, EPA could increase its cost-per ton thresholds for point sources, expand its consideration of pollution sources beyond power plants and other point sources, or lower the level of air quality impact that would be considered "significant." It could also encourage more states to create their own mobile source emission reduction incentive programs like California's Carl Moyer program or Texas Emission Reduction Plan (TERP).

4. Improve Implementation of Exceptional Events Rule and International Transport Provisions to Better Account for Uncontrollable Pollution: In light of the large amount of effort that can go into exceptional events demonstrations, EPA should work with its regional offices to ensure that a consistent, rigorous, and transparent standard is applied to the review of these demonstrations that also accounting for differences in circumstances across the country. In addition, since 179B(a)(2) allows states to model attainment of the NAAQS "but for emissions emanating from outside of the United States," EPA should consider all emissions from outside of the U.S., not just anthropogenic emissions, in considering approval of 179B demonstrations.

5. **Modify Approach to SIP Requirements and Classifications for Nonattainment Areas:** EPA should consider using the more general nonattainment planning requirements of Title I, Part D, Subpart 1 for implementing NAAQS in situations in which doing so may be legally permissible instead of only considering the use of the pollutant-specific planning framework specified under Subparts 2-5.[13] We recognize that EPA would need to weigh the uncertainties involved with pursuing this type of implementation given the various constraints the courts have placed on them in this regard, there are many ways in which Subpart 1 implementation could provide more expeditious and efficient attainment and maintenance of the NAAQS than continued implementation of Subparts 2-5 for new NAAQS that were no in place in 1990. To the extent that EPA continues to use the Subpart 2 framework for O_3 nonattainment areas, it should consider alternative approaches to classifying areas that the 2001 *Whitman v. ATA* decision may allow in order to avoid classifying so many areas as "Marginal." These areas are not required to have any attainment plan and if such areas are not expected to attain the NAAQS within three years, a "Marginal" classification can be problematic. Examples of alternatives include using modeling to assess the likelihood of attaining the NAAQS within 3 years of designation or using the 1990 distribution of nonattainment areas into these classifications.

6. **Ensure Timeliness of Actions Related to SIPs:** EPA should commit to completing the review and approval or disapproval of SIP submissions by the deadlines specified in the Clean Air Act, and should provide notice to states, tribes, and local governments of the potential need to revise a SIP as a result

of failure to attain the NAAQS at the earliest possible date. If additional resources are needed to accomplish this, EPA should request these resources from Congress.

7. **Consider Issuing "Early Action" SIP Calls to Address Problems Maintaining the NAAQS:** In situations in which an area designated as "attainment" violates the NAAQS but is not subject to a maintenance plan, EPA should consider exercising its authority under Section 110(k)(5) to call on states and tribes to submit revisions to their plans if they determine them to be inadequate to attain or maintain the NAAQS as an alternative to designating these areas as "nonattainment. While circumstances now are different, this could be implemented in a manner similar to EPA's highly successful "Early Action Compacts" from 2002-2004.

8. **Consider Updating Transportation Conformity Policies and Practices:** EPA should work with the Association of Metropolitan Planning Organizations (AMPO), the American Association of State Highway and Transportation Officials (AASHTO), and other stakeholders to review and update its transportation conformity rules and practices. There are significant inefficiencies in the current process, and targeted updates can help ensure that EPA's implementation of this requirement does not create an undue burden on transportation planning efforts. EPA should also consider this in light of the substantial emission reductions projected for on-road sources that have already been achieved and are expected to continue well into the future as a result of existing on-road mobile source controls implemented by EPA, states, local governments, and tribes.

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7 https://gispub.epa.gov/air/trendsreport/2020/
8 Baseline emissions for lead is the 2008 NEI as listed in the Trends inventory to most closely match the 2010 baseline for monitoring data.
9 https://gispub.epa.gov/air/trendsreport/2020/
10 https://www.epa.gov/air-trends/air-quality-national-summary. "Number of People Living in Counties with Air Quality Concentrations Above the Level of the NAAQS in 2020"
11 https://www.epa.gov/air-trends/air-quality-national-summary. "Number of People Living in Counties with Air Quality Concentrations Above the Level of the NAAQS in 2019"
12 A notable exception was EPA's announcement in May 2021 that it would modify the boundaries of the Chicago, St. Louis, Door County WI, Manitowoc County WI, Sheboygan County WI, Northern Milwaukee/Ozaukee Shoreline WI nonattainment areas and was proposing to expand the Dona Ana County, NM and Denver Metro/North Front Range, CO nonattainment areas.
13 For example, the 2001 *Whitman v. ATA* and the 2006 *South Coast v. EPA* decisions allow for consideration of the use of Subpart 1 for O_3 nonattainment areas with design values below 90 ppb, which includes all but two O_3 nonattainment areas as of the end of 2019.

Hazardous Air Pollutants

Background

Whereas most of Title I of the Act addresses so-called "criteria pollutants" (because listing is based on the criteria documents dictated under Section 109), Section 112 is dedicated to "hazardous air pollutants." Section 112 was substantially revised in 1990. Prior to 1990, Section 112 defined a "hazardous air pollutant" as "an air pollutant to which no ambient air quality standard is applicable and which in the judgment of the Administrator causes, or contributes to, air pollution which may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness." 42 U.S.C. § 7412(a)(1) (1970). Section 112 required EPA to compile a list of HAPs and akin to the process under Section 111 (New Source Performance Standards), EPA was to propose standards for the newly-listed HAP and finalize those regulations within just 180 days. Standards were required to be set in a manner that protected public health with an "ample margin of safety." 42 U.S.C. § 7412(b)(1)(B) (1970).

Given these tight timeframes and the underlying assumption in the statute that EPA would be able to access easily the information it needed to establish regulations, as well as the ambiguity as to the scope of coverage required for regulating a given HAP, once listed, the program only had limited success. These timeframes and ambiguities meant that EPA was only able to issue a seven HAPs standards prior to 1990.

The 1990 Amendments established a more methodological approach to HAP regulation. First, it provided a finite list of HAPs to eliminate the "listing" step in the regulatory process. Congress listed 188 HAPs. 42 U.S.C. § 7412(b). Second, it directed EPA to establish a list of source categories of "major sources" of HAPs (defined as a source with the potential-to-emit 10 tons per year (tpy) of a single HAP or 25 tpy of combined HAPs) and to do so by 1992. Third, it established a two-step regulatory process, consisting of setting technology-based standards under Section 112(d) at the outset and then 8 years later evaluating whether risk remains that warrants further regulation of the source category. 42 U.S.C. §§ 7412(d), (f). The technology-based standards for major sources are commonly called MACT standards (maximum achievable control technology). New source MACT is set based on the emissions control achieved by the best controlled similar source, and existing source MACT is set based on the average emission limitation achieved by the best performing 12 percent of existing sources in the category or subcategory. 42 U.S.C. §§ 7412(d)(3). The schedule for establishing the initial technology-based standards for major sources was aggressive, requiring all of the standards to be issued by the end of 2000.
42 U.S.C. §§ 7412(e).

Section 112 also establishes an "area source" program, which are those sources with potential emissions below the major source thresholds. Section 112(d) authorizes, but does not require, EPA to issue area source standards for source categories. Area sources are typically subject to the less stringent "generally available control technology" or GACT standards.

Finally, in 1990, Congress added to Section 112 a provision addressing prevention of sudden, catastrophic releases of air toxics by establishing an independent Chemical Safety and Hazard Investigation Board. The Board is responsible for investigating accidents involving releases of hazardous

substances, conducting studies, and preparing reports on the handling of toxic materials and measures to reduce the risk of accidents.

Section 112(r)(7) directs EPA to issue prevention, detection, and correction requirements for catastrophic releases of air toxics by major sources, which are referred to as the Risk Management Program or "RMP" regulations. Section 112(r)(7) requires owners and operators of stationary sources storing regulated substances at specified threshold quantities to conduct worst-case release scenario modeling and to prepare risk management plans including hazard assessments, measures to prevent releases, and a response program.

Successes

The structure of Section 112 and substantial effort by EPA, state agencies implementing Section 112 requirements, and regulated entities implementing the standards have led to a series of significant accomplishments since 1990:

1. EPA met Congress's directive to list categories of major sources under Section 112 for regulation under the aggressive 10-year schedule set by Congress for technology-based MACT standards by initially listing 174 categories.[14]
2. EPA issued *97* MACT standards covering *all of the 174 major source categories* originally listed by the Agency.[15]
3. EPA has issued MACT standards based on performance of technologies but hewing to Congress's direction to establish performance-based standards that allow companies to achieve the standards in the most cost-effective manner available.
4. EPA has also regulated 68 area source categories, such as dry cleaners, hard chromium plating operations, aluminum foundries, and synthetic rubber manufacturing.[16]
5. EPA has completed approximately 90 Residual Risk and Technology Reviews (RTRs) under Sections 112(d)(6) and (f), and it is scheduled to complete 8 additional RTRs before the end of 2022.[17] EPA's residual risk analyses have determined that the regulated industry has achieved emission levels for virtually every major source category regulated by MACT standards sufficient to protect public health and the environment with an ample margin of safety.
6. EPA's implementation of the Urban Air Toxics program has made substantial progress to reduce air toxics across the country since the adoption of the Integrated Urban Air Toxics Strategy in 1999. The Agency's *Second Integrated Urban Air Toxics Report to Congress*, issued in 2014, outlines this progress. The report confirms that the country has made substantial progress, having eliminated millions of tons of toxic pollutants over the last two decades, including:
    - 6.1. A 66 percent reduction in benzene;
    - 6.2. A nearly 60 percent reduction in mercury from man-made sources like coal-fired power plants;
    - 6.3. An 84 percent decrease of lead in outdoor air;

6.4. From 1990 through 2012, the removal of an estimated 1.5 million tons per year of hazardous air pollutants (HAPs) from stationary sources, and approximately 3 million tons per year of criteria pollutants as a co-benefit of HAP reductions;

6.5. The removal of an estimated 1.5 million tons per year of HAPs from mobile sources, which represents a 50 percent reduction in mobile source HAP emissions.[18]

7. EPA's Urban Air Toxics Outreach and Education program has supported numerous education and outreach initiatives including:

7.1. Training programs through the Institute for Tribal Environmental Professionals, the online Air Pollution Training Institute and the Environmental Justice community are delivering critical information to state, tribal and local partners that implement air toxics rules.

7.2. EPA funding for air monitoring initiatives, including monitoring near roadways in larger cities, and grants for community-scale air monitoring, have empowered communities and individuals to take action to avoid air pollution exposure using routine and low-cost portable air pollution sensors.

7.3. Partnerships with the National Association of Clean Air Agencies, the National Tribal Air Association and the National Environmental Justice Advisory Council foster community capacity building and help improve understanding of local air toxics issues.[19]

8. Companies have implemented the Risk Management Plan provisions of the Clean Air Act Section 112(r), conducting analyses of hazards and mitigating them as well as planning for response actions. "The Risk Management Program is about reducing chemical risk from accidental releases at the local level. The RMP information helps local fire, police, and emergency response personnel (who must prepare for and respond to chemical accidents) and is useful to citizens in understanding the chemical hazards in communities."[20]

9. Dating back to 2002, EPA has completed 7 National Air Toxics Assessments (NATA) as screening tools for states, local, and tribal air agencies for health risks from exposure to HAPs across the country. The NATA helps agencies identify which pollutants, emission sources, and locations to study further to understand risks and mitigate risks from ambient exposure to HAPs within their jurisdictions at the census tract level. The scope of the NATA has increased significantly over the past twenty years, covering 32 HAPs in the initial report and now covering 180 HAPs in the two most recent reports. The NATA has numerous applications at the national, state, and local levels, including informing priorities for improving emissions inventories, expanding the air toxics monitoring network, helping target risk reduction activities, and helping communities design their own assessments. Two other notable applications of the NATA are its inclusion in EPA's Environmental Justice Screen tool and its use in scoring criteria for Diesel Emission Reduction Act (DERA) grant awards." https://www.epa.gov/national-air-toxics-assessment

Future Challenges and Opportunities

While the core technology program and residual risk programs have been a substantial success, and Americans are healthier and safer as a result, additional opportunities remain under the statute.

1. Completion of residual risk analyses for source categories under Section 112(f) is an important aspect of the program has been delayed for a range of reasons – with the majority of those deadlines coming due in the 2005 to 2015 time frame. While it is recognized that the delay is partially attributable to the large number of source categories EPA has regulated under Section 112(d), it is a high priority to complete this congressional charge.

2. EPA has also struggled to complete the technology reviews under Section 112(d)(6), which require EPA to update standards if necessary, taking into account developments in practices, processes, and control technologies.

3. Current standards, although written as performance standards, may stifle innovation and opportunities for pollution prevention because the standards are written in a very prescriptive manner (in part to assure enforceability).

4. To date, EPA's cost analyses have not been keyed to the actual costs of implementation of the requirements. To its credit, EPA has undertaken some retrospective analyses to compare its pre-regulatory costs and benefit forecasts with actual experience.

5. Section 112 standards can be exceedingly difficult to interpret and apply. This is due to several factors. For example, many standards include cross-referencing between subparts of part 63 (e.g., incorporating by reference language from one source category standard into another, which requires a regulated entity to cross-reference several standards to determine the regulatory language that applies to a given piece of equipment). In addition, standards may include complex cross-references even within standards that make interpretation difficult. And, EPA often issued (as a cost-savings measure for the agency) standards for multiple source categories in a single rulemaking action, which led to confusion regarding the preamble statements and interpretations that applied to particular regulatory language. Another example is the rationalization and updating of standards that are subject to subsequent court decisions (such as for the startup, shutdown, and malfunction provisions).

Recommendations

1. EPA should endeavor to complete as expeditiously as practicable the remaining residual risk analyses for source categories that have not yet been addressed under Section 112(f). EPA should communicate to Congress the challenges that it faced with respect to completing these reviews in the time frame allotted.

2. EPA should be timely in its technology reviews under Section 112(d)(6). Like the Section 112(f) reviews, the challenges inherent to the timing and approach to these reviews may be an issue worthy of review. EPA should communicate to Congress the challenges that it faced with respect to completing these reviews in the time frame allotted.

3. EPA should advise Congress on what the frequncy of updates should be in light of resources available and the pace with which technology advancements are expected to occur. – EPA could set up streamlined tech reviews when an initial indicates no meaningful adv. Cite to proposed rule. Publish a FR notice – we are not aware of any new tech, unless we get info to the contraray, this is done. EPA should find ways under existing authrity to streamline the process especially where the RBLC indicates that advances in tech have not been demonstrated. HAPs are either VOC or particulate. For

a large number, the existing databases would indicate that there is no advancement worthy of rulemaking, thus enabling an efficient discharge of this statutory obligation in most instances.

4. EPA should consider ways to ensure that innovative compliance approaches can still be allowed, which could reduce costs and also provide for even greater emissions and risk reduction.

5. EPA should use the lessons from retrospective cost analysis comparisons in order to enhance pre-regulation cost/benefit forecasts for future rulemakings.

6. EPA should attempt to simplify Section 112 standards where possible to facilitate both compliance and enforcement. It would be beneficial for EPA to continue its efforts to simplify and make standards clear so that regulated entities, state regulatory agencies, and EPA regional offices can all arrive at the same conclusions regarding compliance.

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[14] EPA, "National Air Toxics Program: The Second Integrated Urban Air Toxics Report to Congress," at 2-4 (Aug. 21, 2014), *available at* https://www.epa.gov/sites/production/files/2014-08/documents/082114-urban-air-toxics-report-congress.pdf.
[15] *Id.*
[16] *See id.* at 2-3; *see also* EPA, "National Emissions Standards for Hazardous Air Pollutants - Area Source Standards," *available at* https://www.epa.gov/stationary-sources-air-pollution/national-emissions-standards-hazardous-air-pollutants-area-source-0 (last updated Feb. 11, 2021).
[17] *See* EPA, "Risk and Technology Review of the National Emissions Standards for Hazardous Air Pollutants," https://www.epa.gov/stationary-sources-air-pollution/risk-and-technology-review-national-emissions-standards-hazardous (last updated Mar. 16, 2021).
[18] EPA, "Fact Sheet: Second Integrated Urban Air Toxics Report to Congress -- Progress And Actions To Address Risks From Air Toxics," (Aug. 21, 2014), *available at* https://www.epa.gov/sites/production/files/2014-08/documents/082114-fs-urban-air-toxics-report.pdf.
[19] EPA, "Urban Air Toxics Outreach and Education," *available at* https://www.epa.gov/urban-air-toxics/urban-air-toxics-outreach-and-education (last updated Feb. 24, 2021).
[20] EPA Fact Sheet, "Clean Air Act Section 112(R): Accidental Release Prevention /Risk Management Plan Rule, (Apr. 2020)," *available at* https://www.epa.gov/sites/production/files/2020-03/documents/caa112_rmp_factsheet_march_2020_final.pdf.

Stationary Sources

Background

This section addresses the stationary source permitting programs under the Clean Air Act, specifically, major new source review (NSR), which is comprised of major nonattainment NSR (NNSR) and Prevention of Significant Deterioration (PSD) permitting programs, minor NSR permitting, and Title V operating permits. It also addresses the related New Source Performance Standards (NSPS) under Section 111 of the Act. It does not include Section 112 programs, as those are addressed in a different section.

Congress established the NSPS program in 1970 to establish a base level of controls for certain categories of emission units to be listed by EPA. In contrast to NSR programs, NSPS focuses on *industry categories* rather than on pollutants. All new sources in a listed industry category must comply with the NSPS, unless they were already under construction when the standards were proposed. In addition to applying to new sources, NSPS apply to modified and reconstructed sources in a listed source category. The process begins with listing source categories for which EPA makes certain specified endangerment findings, after which emission standards are set. EPA has listed hundreds of source categories and issued standards for new sources, which also apply to existing facilities if they are modified or reconstructed. The emission standards are based on the "best system of emission reduction" as determined by the Administrator. EPA has utilized the NSPS program to regulate greenhouse gases (in the form of carbon dioxide and methane) in recent years from certain source categories. This section of the report does not address the climate change actions because those actions are being addressed in a separate section of this report, dedicated to climate change. Please refer to that section for additional information on climate regulation under the NSPS.

Minor NSR, PSD, and NNSR permitting requirements are all pre-construction permitting programs authorized under Title I of the Act, *via* Sections 110, 165, and 172, respectively. NNSR and PSD apply generally to major sources and minor NSR applies to both major sources and minor sources. While this report cannot do justice to the scope and complexity of these programs due to the report's limited length, it attempts to highlight the major accomplishments of the programs as well as challenges and opportunities going forward. The preconstruction permitting programs have been in the statute since the 1970s. The Title V operating permit program was added by the 1990 amendments to the Clean Air Act.

NNSR and PSD apply only to major sources and only when certain triggering events occur—i.e., construction of a brand new facility (e.g., an automobile assembly plant, a chemical production facility) that has the potential to emit over 100 or 250 tons per year (tpy) or a major modification of an already major-emitting facility occurs. The underlying policy of these major source and major modification programs is that when significant investment is being made in a facility, that is the best time to install controls so that they can be designed in at the outset rather than retrofitted later, which is as a general matter, always more costly and may not be able to be accomplished as efficiently. NNSR and PSD are typically implemented by state or local agencies, either under an "approved" program or under a "delegation" from EPA. While in each scenario, the state or local agency issues the permit or determines if a permit is required, a state/local agency with an approved program is implementing its own

regulations, which may differ from the federal regulations, but need to as a minimum meet those requirements.

PSD applies in attainment areas and often requires air quality modeling to provide assurance that new emissions being added to the airshed will not cause an area to fall into nonattainment, hence the moniker "prevention of significant deterioration". NNSR applies in nonattainment areas and is intended to allow growth in areas even if they are not attaining a NAAQS, but it imposes certain emission offset requirements, which may require the emissions to be offset at a larger than 1:1 ratio, depending on pollutant and severity of the nonattainment problem.

Minor NSR programs are adopted by state/local agencies under Section 110 of the Act. Minor NSR is a bit of a misnomer because it applies to both major and minor sources. State/local agencies design their minor NSR programs to address local air quality and industry needs and they typically apply below the major source or modification thresholds. Thus, although a new facility may not trigger NNSR or PSD permitting requirements, it will still be subject to the applicability thresholds and applicable additional permitting requirements of the state/local minor NSR program.

Title V is different than the NSR programs in that it is an *operating* permit program. Title V does not impose substantive requirements.[21] Rather it collects and lists the substantive requirements from other titles of the Act in a single document, referred to as the operating permit. In general, Title V applies to major sources as defined in other substantive titles and as a backstop, it defines a major source as any source with potential emissions of 100 tpy or more. Certain specified non-major sources must also obtain Title V permits. For reference, EPA summarizes the sources that are subject to Title V permitting on its website. https://www.epa.gov/title-v-operating-permits/who-has-obtain-title-v-permit. The Title V program was launched in 1990 and initially covered some 35,000 sources. That number has declined substantially as companies have undertaken efforts to reduce potential and actual emissions through pollution prevention, changes in technology, and willingness to accept restrictions on operations. EPA has estimated that this number has been reduced to about 15,500 facilities that remain subject to the Title V program after these emission reduction efforts.[22] Title V also imposes fee requirements on facilities that are subject to the program, which are intended to fund the costs of that program. In general, the presumptive minimum fees required to be collected are based on actual emissions from facilities in an area ($25 per ton in 1990 dollars). States, however, can collect fees in any form they like (e.g., based on allowable emissions, on a per facility flat fee basis, per application, per modification), provided that they establish that their Title V program will be adequately funded and that the fees collected will be used solely for Title V costs.[23] Although Title V does not provide authority to add new substantive requirements, it does provide for new compliance monitoring, recordkeeping, and reporting. It also includes a "petition process," whereby citizens can petition EPA to object to a Title V permit if it finds that the Title V permit does not comply with applicable requirements of the Act. Finally, Title V requires permittees to submit semi-annual reports of required monitoring and annual compliance certifications. Successes

For ease of review, we divide the successes, challenges, and opportunities based on the Title I permitting programs, under which EPA has authority to impose new substantive requirements, and the Title V operating permit program, through which the substantive requirements established under other titles of the CAA are consolidated and listed in a single document, and thus is not a substantive program.

Successes

1. Title I Permitting

    1.1. States and local agencies implement both delegated and approved NNSR, PSD, and minor NSR programs. This means that almost uniformly across the country, the permitting agencies that are state or locally-based are making the front-line permitting decisions. This is important in the scheme of the statute because Congress intended for a cooperative federalism approach in which there would be local autonomy in making local air quality decisions. Nowhere is this more important than in permitting of economic growth.

    1.2. Title I PSD permitting was extended to greenhouse gases following the Supreme Court's decision in 2014, in a manner that was intended not to overwhelm the PSD permitting program. Under this approach, which is often called the "anyway" approach, PSD is triggered for greenhouse gases only when it is already being triggered for a criteria pollutant *and* there is a significant increase in CO_2-equivalent emissions (with a current significance level of 75,000 tpy CO_2-e).

    1.3. The technology-forcing nature of the best available control technology (BACT) (applicable for PSD) and lowest achievable emission rate (LAER) (applicable for NNSR) requirements have helped to advance technology for reducing criteria pollutant emissions.

    1.4. To address several criticisms of the NSR programs, EPA issued the NSR Improvement Rule of 2002, which helped to rationalize and resolve several of these criticisms. Virtually all those regulatory changes were upheld in a court challenge and states have made substantial progress in adopting those reforms, with EPA largely approving them.

    1.5. The Plantwide Applicability Limit (PAL) provisions of the NSR Improvement Rule built on innovative permits that were issued over the decade preceding that 2002 action. Since 2002, numerous PALs have been issued, and these PALs resulted in substantial emissions reductions over what would have been required under a traditional NSR applicability approach, while simultaneously streamlining the procedural requirements that apply for facilities that do not have PAL permits. Although resource intensive to obtain, PAL permits represent a win-win opportunity for all stakeholders.

2. Title V Permitting

    2.1. All States have achieved approval of their Title V programs and are implementing them.[24] The federal structure provides consistency and uniformity for the operating permits.

    2.2. As of January 2008, 99% of all original permits required for Title V sources had been issued.[25]

    2.3. Companies have invested in pollution prevention and new technology to avoid Title V permitting applicability, which means that the number of sources originally projected has been reduced by about 50%. While Title V does not impose substantive requirements, the efforts by companies to avoid the procedural costs of Title V by implementing emission reduction programs to do so is an unintended benefit of the program.[26]

    2.4. According to a CAAAC -commissioned investigation into the performance of Title V, which culminated in a 2006 Report to the Committee, *Final Report to the Clean Air Act Advisory*

Committee: Title V Implementation Experience (April 2006), https://www.epa.gov/caaac/title-v-performance-task-force-report-clean-air-act-advisory-committee, a cross-section of stakeholders saw benefits from the Title V operating permit program as including:

2.4.1. Recordation of applicable requirements into one document;

2.4.2. Public participation and education;

2.4.3. Permitting authority/facility interaction that facilitated communication and understanding of compliance obligations;

2.4.4. Strengthened compliance assurance systems, specifically the requirement for annual compliance certifications and semi-annual reports of required monitoring that must identify deviations from permit requirements to facilitate periodic examinations and reporting of compliance status.

2.5. States and EPA have transitioned to electronic reporting to a large extent, though there remain challenges related to the interaction of federal and state systems (e.g., CEDRI v. state-based systems and state systems' inability to accept the federal electronic reporting, creating duplicative reporting requirements) and that many states still require duplicative manual submissions.

3. NSPS

3.1. EPA has issued [fill in] NSPS emission limitations in the context of [FILL IN] source category standards. These technology-based standards apply on an "affected source" basis, which is beneficial in that they are specific to the emissions unit.

3.2. The NSPS standards serve as a baseline for technology determinations in numerous other programs, such as the preconstruction permitting programs and as a basis for making reasonably available control technology and other determinations under the Act.

Challenges and Opportunities

1. Title I Permitting

1.1. There remains a host of guidance, which can be conflicting with other guidance and interpretations, making it difficult for facilities to navigate even the applicability framework, much less to comply with the substantive requirements of the programs.

1.2. Obtaining applicability determinations from EPA or states is time-consuming and typically out of sync with the timeframe for business decision making.

1.3. The timing for obtaining both major and minor NSR permits is reported as being extremely slow, potentially hampering economic growth.

1.4. There is a lack of available monitoring data for PSD modeling analyses.

1.5. The ever-increasing stringency of NAAQS standards has created substantial challenges for states and facilities in the process:

1.5.1. When NAAQS become more stringent, permits in process may need to start the process over or undergo substantial revisions and this issue has been exacerbated by court decisions stringently interpreting the language of the statute.

1.5.2. The ability to model attainment or show non-interference has become problematic for pollutants that previously had not presented obstacles to growth.

1.5.3. The lag between issuance of a revised/new NAAQS and the implementation rule leaves states and companies at a disadvantage in planning that needs to be remedies.

1.6. The cost of Title I permitting requirements for modifications is very high but the data on the emissions reductions achieved and impact on overall air quality may not align with those resources.

1.7. Case precedent on Title V petition processes has created uncertainty for companies and states seeking to rely on Title I permitting decisions.

1.8. Offsets for certain pollutants in many nonattainment areas have been very scarce. In some cases, this means the cost of offsets is extremely high, whereas in others, there may be no offsets available, meaning that a beneficial project cannot proceed or may need to be located at a different location, either domestically or internationally, impacting opportunities for growth and productive capacity expansion in the areas that may have relied on them.

2. Title V Permitting

2.1. The timing for processing Title V modifications and renewals has been reported as excessive and slowing progress on implementing beneficial plant changes.

2.2. While EPA has made substantial progress in reducing the backlog of Title V petitions, the timing for response to Title V petitions still needs to be reduced.

2.3. Because facilities have substantially reduced emissions, states that base fees on actual emissions have reported struggling with funding. This has caused many states to dramatically increase their permitting fees.

2.4. Inconsistent reporting format at the federal and state levels have created challenges as EPA moves to uniform reporting under CEDRI.

2.5. The permit objection process which holds permit terms in limbo pending EPA resolution of objection requests and infrequent or inconsistent use of the permit shield has undermined the ability to achieve the certainty the Title V process was intended to create for companies and for the state permitting authorities that are drafting permits. In exchange for its costs, the Title V program was to create a document on which the source could rely as representing Clean Air Act compliance. Where permit objections linger in a state, the permitting authority has uncertainty about whether the permits it is issuing may need to be reopened based on a pending objection for an issue that occurs in all or many of its other permits.

3. NSPS

3.1. EPA has struggled to complete technology reviews required every 8 years under Section 111(b)(1), which require the agency to "review and, if appropriate, revise" NSPS, unless EPA "determines that such review is not appropriate in light of readily available information on the efficacy of such standard."

3.2. Current standards, although written as performance standards, may stifle innovation and opportunities for pollution prevention because the standards are written with specific technology in mind and not all NSPS include options for alternative compliance demonstration methods, meaning that a new rulemaking may be required. While the innovative technology waiver is a potential option, because of constraints in the statute on how to qualify for it, it has not been used very often.

Recommendations

1. Title I Permitting

1.1. EPA should rationalize and reconcile the thousands of NSR guidance documents to aid understanding of what guidance applies, particularly with respect to the threshold question of applicability or where historic guidance documents present conflicting outcomes.

1.2. EPA should take steps to expedite both permits and applicability determinations. To date, EPA has focused on processing permits that are issued by EPA as the permitting authority. With respect to Title V, one potential step would be to audit states on their processing times for significant Title V modifications, given the statutory directive to provide for expeditious processing.

1.3. EPA should continue to encourage companies and states to adopt PALs. EPA's 2020 PAL Guidance Document represents a good first step in this process, but more can be done to realize the potential of PALs.

1.4. EPA should take steps to address the problems created by the significant impact level (SILs) case law.

1.5. EPA should adopt NAAQS implementation rules addressing NSR implications simultaneously with issuance of a revised NAAQS.

1.6. EPA should enhance the air quality monitoring networks to facilitate PSD permitting and should explore public-private partnerships (e.g., as have been instituted in Texas) to support this effort.

1.7. EPA should conduct a study to assess the relative benefits of NSR permitting compared with the costs and make recommendations as to whether additional streamlining can be done within the current statutory framework.

2. Title V Permitting

2.1. EPA should work to implement the remaining majority recommendations of the Clean Air Act Advisory Committee's Title V Task Force or explain why it is not proceeding with them.

2.2. EPA should continue its work to reduce the timeframe for responding to Title V petitions. Over the past four years, substantial progress was made in reducing the backlog that had built up over time. Continued focus will foster further improvement.

2.3. States and EPA should ensure that appropriate fees are being collected to support the Title V program, which should include ensuring that Title V fees are spent on Title V activities and not broader Clean Air Act implementation costs. EPA should determine the true cost of Title V permitting and provide support for diversification of fee structures, as the presumptive minimum approach is outdated and no longer a sustainable and equitable approach.

2.4. EPA should work with states to improve processing time for permit modifications.

2.5. EPA should work with states to improve processing rates for permit renewals.

3. NSPS

3.1. EPA should make efforts to streamline the technology reviews under Section 111(b)(1). EPA should review the advance notice of proposed rulemaking that it issued in 2011 on improving the review process and determine if a rulemaking would be appropriate on this topic. *See New Source Performance Standards (NSPS) Review,* 75 Fed. Reg. 65,653 (Oct. 24, 2011).

3.2. EPA should evaluate expanded use of alternative means of emission limitation when it is issuing or revising NSPS.

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[21] Copeland, C., *Clean Air Act Permitting: Implementation and Issues*, Congressional Research Service, at 2 (Sept. 1, 2016) (CRS Report).
[22] CRS Report at 1.
[23] In the early 1990s, EPA issued an interpretation that would have required states to show that fees would fund all substantive programs of the Act under the statute. Following a legal challenge, that interpretation was withdrawn and EPA hewed to the statutory language on fees.
[24] CRS Report at 3 ("As of June 1997, EPA had approved permit programs for all 114 submissions by states, local agencies, and territories.").
[25] CRS Report at 4.
[26] CRS Report at 7 ("… Title V is an administrative program and was not intended to have a direct impact on emissions. Permitting agencies, however, say that many major sources have voluntarily restricted their operating conditions or installed pollution controls in order to reduce emissions below the Title V regulatory thresholds …, which is a plus for the environment.")

Visibility and Regional Haze

Introduction

Congress's 1977 amendments to the Clean Air Act established a national program for addressing visibility impairment in national parks, monuments, wilderness areas under what is today section 169A (42 U.S.C. §7479). The statute states, "Congress hereby declares as a national goal the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from manmade air pollution." There are a total of 156 Class I areas across the country.

Figure 1. Mandatory Class I Areas

EPA promulgated the first set of visibility regulations in 1980 that required 35 states and the Virgin Islands to:

1. Revise their State Implementation Plans (SIPs) to assure progress toward the national visibility goal.
2. Determine which existing stationary facilities should install the Best Available Retrofit Technology (BART) for controlling pollutants which impair visibility.
3. Develop, adopt, implement, and evaluate long-term strategies toward making reasonable progress toward remedying any existing and future impairment in Class I areas.

4. Adopt measures to assess potential visibility impacts due to new or modified major stationary sources, notify federal land managers (FLMs) of proposals for new or expanded facilities, and consider visibility analyses conducted by FLMs in their permitting decisions.

5. Conduct visibility monitoring in Class I areas.

EPA further added to these provisions in the 1990 amendments under what is now section 169B (42 U.S.C. §7479) that requires EPA to conduct additional research and reporting to Congress and required the establishment of a broader regional commission to address visibility issues in the Grand Canyon.

In 1999, EPA adopted the "Regional Haze Rule" to address the issue more comprehensively by evaluating and regulating impacts on visibility across large areas crossing state boundaries.[27] This rule expanded applicability to all states, which meant that an additional 15 states would be required to submit SIP revisions to support regional haze planning. Plans were required to submit their initial plans between 2006 and 2008 and were required to submit reports on "reasonable progress goals every five years thereafter. A complete revision of the plan was required every 10 years after the initial submission. Under the program, EPA issued a number of new regulations and guidance documents that further shaped the program ahead of the deadline for states to submit their first regional haze SIP revisions. For example, EPA established a requirement that states compare visibility conditions in 2000-2004 for the most impaired days with "natural background conditions."[28] States are to use this comparison to determine the amount of progress that is needed to reach these conditions in 60 years, *i.e.,* 2064.[29]

Accomplishments

1. Average visibility in national parks and wilderness areas have significantly improved in the vast majority of areas of the country. This includes both the clearest days and the most impaired days. **Error! Reference source not found.** shows the trends across the country on the worst impaired days from EPA's 2021 Trends Report.[30] As referenced in Title IV section, substantial reductions in SO_2, on the order of 95%, have been made in the electric generation sector, along with reductions in NOx which fell by 88% from 1990 to 2020.[31]

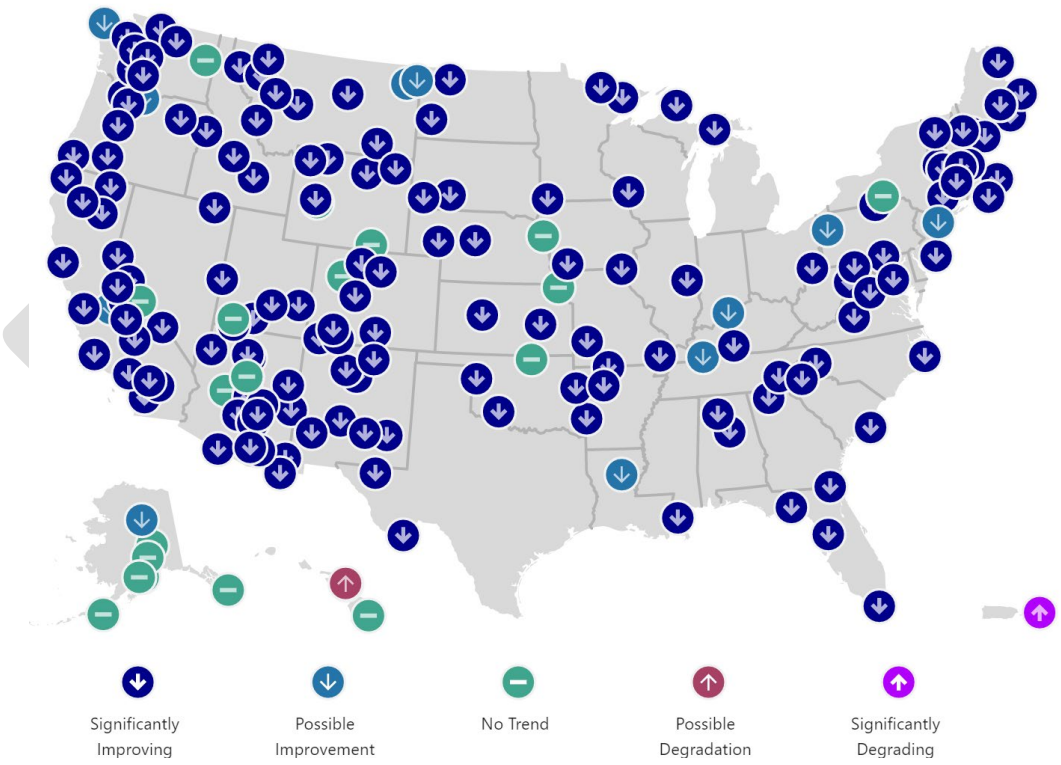
2. The 10 most heavily visited National Parks with visibility monitors all showed notable improvements in visibility on the most impaired days from 2000-2019.[32]

Table 2. Visibility Improvements at Ten Most Visited National Parks, 2000-2019

Park	Visitors in 2020 (Millions)	Visibility Improvement
Great Smoky Mountains, NC	12.3	42%
Yellowstone, WY	3.8	12%
Rocky Mountain, CO	33.3	11%
Grand Canyon, AZ	2.9	22%
Acadia, ME	2.7	33%
Olympic, WA	2.5	19%
Joshua Tree, CA	2.4	23%
Yosemite, CA	2.2	33%
Glacier, MT	1.7	17%
Shenandoah, VA	1.7	44%

3. Across all 183 visibility monitoring stations covered by the Regional Haze Program, the vast majority have seen "significant improvement" (149 sites), and another 13 have shown "possible improvement."
4. These improvements significantly increase the ability of visitors to enjoy the full beauty that these treasured places have to offer.
5. While improvements in visual ranges are due to many different Clean Air Act programs, the regional haze program and the emission reduction measures specific to its requirements, such as any measures required under "Best Available Retrofit Technology", have also significantly contributed to improvements in visibility in these areas.
6. By providing a comprehensive framework for conducting planning around this issue and requiring the input of other federal agencies including the U.S. Forest Service, U.S Fish and Wildlife Service, and the U.S. National Park Service, the regional haze program requires that states and the federal government devote attention specifically to this issue at least once every five years, and thereby serves as a reminder to the whole country that this issue remains important.

Figure 2. Visibility Trend on Most Impaired Days



Future Challenges

1. While most areas have seen improvements in visibility, 21 have not, representing 11% of all monitoring sites.

2. Two sites have seen significant degradation or "possible degradation:"

   2.1. Significant degradation: Virgin Islands NP, 7% degradation 2001-2019

   2.2. Possible degradation: Haleakala NP: 12% degradation 2001-2011

3. Since 2006, EPA has allowed pollution trading programs to fulfill BART emission reduction requirements. This issue continues to be disputed since BART is intended to apply to specific sources tied to impairment in specific Class I areas, while interstate trading programs are designed to address attainment and maintenance of the O_3 and $PM_{2.5}$ NAAQS and would not necessarily address pollution coming from the specific sources identified for a Regional Haze analysis. Courts have upheld the authority of EPA to consider that interstate rules can provide reductions that are "better than BART" but more recent rules have substantially restricted trading within the CSAPR region). In January 2021, EPA announced that it would be reconsidering its 2017 decision affirming that the ability to rely on the Cross State Air Pollution Rule (CSAPR) to fulfill BART requirements, and as of the writing of this report, this issue has not yet been resolved.

4. The Regional Haze program rules allow states determine that no additional measures are needed to improve visibility based on cost of implementation even if modeling showing sources within the state are determined to be having a significant impact on visibility in a Class I area. A state's current program and SIP may also provide more reductions than needed to make "reasonable progress" towards natural visibility conditions. In this situation, when current plans are sufficient or exceed visibility requirements, a significant amount of resources being used by states to prepare and submit SIP revisions, and by EPA to review these SIP revisions, without resulting in actual improvements in visibility. By definition, the program is intended to achieve different types of emission reductions than what are required to attain or maintain the NAAQS, but the program's current implementation can sometimes seem like more of a scientific exercise than a meaningful planning effort designed to achieve additional visibility improvements in Class I areas.

Opportunities

1. While EPA's 2012 PM NAAQS established a distinct secondary annual $PM_{2.5}$ NAAQS related to visibility, the level of the NAAQS is less stringent than the primary annual $PM_{2.5}$ NAAQS and is targeted at urban visibility conditions rather than visibility conditions in Class I areas. The same framework could be used, however, in future reviews of secondary PM, SO_2, and NO_2 NAAQS to support additional emission reductions in Class I areas with the worst visibility conditions.

2. EPA modeling indicates that all Class I areas are projected to see improvements in visibility from 2014-2017 to 2028. These improvements are mostly driven by mobile source emissions standards, implementation of the O_3 and $PM_{2.5}$ NAAQS, new source performance standards, and new source review permitting, providing a good baseline of improvements that would be expected to occur even without additional BART rules.[33]

Recommendations

1. EPA should provide a resource page on its website that provides links to state Regional Haze SIP revisions and related EPA actions, and examples of BART rules that have been adopted by states

along with relevant information about cost, emission reductions expected, etc. comparable across states. This would enhance comparability across all states.

2. EPA should consider conducting a retrospective analysis of the extent to which improvements in visibility since 2000 can be attributed to BART rules relative to other national programs like the Clean Air Interstate Rule (CAIR), CSAPR, Mercury Air Toxics Standards (MATS), and mobile source emissions standards, as well as state and local programs.

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[27] 64 FR 35715
[28] 64 Fed. Reg. at 35,732.
[29] *Id.*
[30] https://gispub.epa.gov/air/trendsreport/2021/#home
[31] https://www.epa.gov/newsreleases/epa-2020-power-plant-emissions-continue-demonstrate-significant-reductions
[32] 2020 attendance numbers from U.S. National Park Service: https://irma.nps.gov/STATS/SSRSReports/National%20Reports/Annual%20Visitation%20and%20Record%20Year%20by%20Park%20(1904%20-%20Last%20Calendar%20Year) monitoring data from EPA Trends Report. Zion NP had the 3rd most visitors in 2020, but only has monitoring data from 2000-2002. Grand Teton NP, Cuyahuga Valley NP, and Indiana Sand Dunes NP had the 4th, 7th, and 11th most visitors in 2020 but had no monitors.
[33] https://www.epa.gov/sites/production/files/2019-10/documents/updated_2028_regional_haze_modeling-tsd-2019_0.pdf

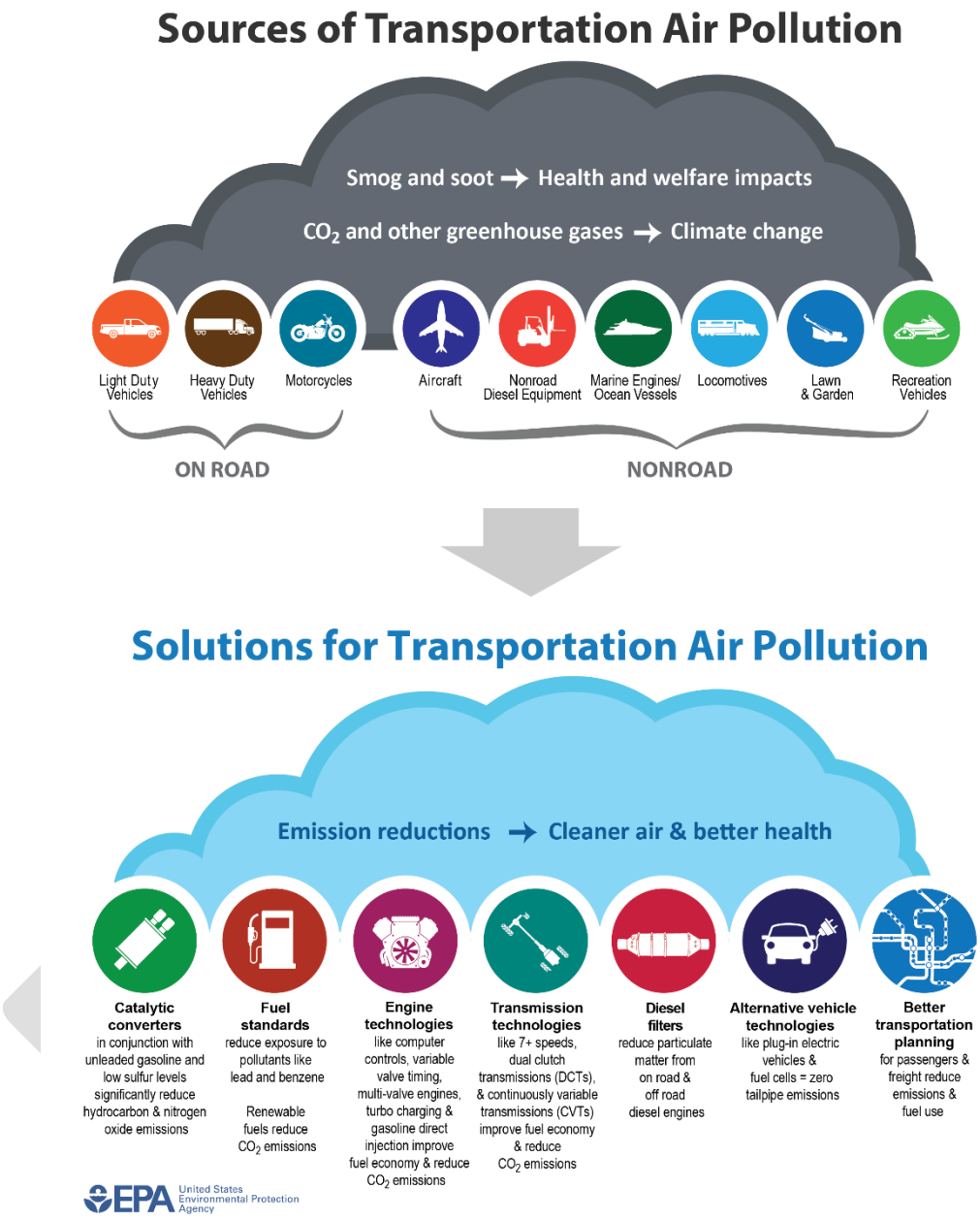
Mobile Sources

Overview

Assessment of air emissions from mobile sources and initial frameworks to regulate such emissions predate the 1970 Clean Air Act. In 1963, Congress amended a 1955 statute which previously required the Surgeon General of the United States, in consultation with state and local governments, to "prepare or recommend research programs for devising and developing methods for eliminating or reducing air pollution."[34] The 1963 statute, also known as the Clean Air Act, found among other things that "the growth in the amount and complexity of air pollution brought about by urbanization, industrial development, and the increasing use of motor vehicles, has resulted in mounting dangers to the public health and welfare, including injury to agricultural crops and livestock, damage to and the deterioration of property, and hazards to air and ground transportation."[35]

Under the 1963 law, the Secretary of Health, Education and Welfare was to "encourage the continued efforts on the part of the automotive and fuel industries to develop devices and fuels to prevent pollutants from being discharged from the exhaust of automotive vehicles."[36] The Clean Air Act Amendments of 1970, now generally referred to as the 1970 Clean Air Act, amended these prior statutes that were primarily focused on collaborative efforts with states, localities and industry to research and define approaches to mobile source air pollution. Specifically, the Act required the Administrator of the newly-created EPA to "prescribe (and from time to time revise) . . . standards applicable to the emission of any air pollutant from any class of classes of new motor vehicles or new motor vehicle engines . . ."[37] As described in more detail below, further amendments to the Clean Air Act after 1970 expanded the reach of the Act to nearly all engines, vehicles and fuels utilized for transportation and other uses in the mobile source sector.

Figure 3. Sources and Solutions for Transportation Air Pollution



Clean Air Act authority over mobile sources involves both authority and direction to promulgate emission standards, as well as further definition as to how and how long such standards will apply. In the 1970 Clean Air Act, Congress specified that emission standards be applicable to the "full useful life" of motor vehicles and motor vehicle engines. Thus, apart from initial compliance when engines and vehicles are manufactured, standards apply over many years while engines and vehicles are in use and acts subsequent to manufacture may be proscribed.[38]

At times, Congress has been prescriptive as to the extent of emission controls required. The 1970 Act directed EPA to promulgate regulations to achieve at least a 90 percent reduction in emissions of carbon

monoxide ("CO") and hydrocarbons ("HC") in Model Year 1975 and a 90 percent reduction in emissions of oxides of nitrogen ("NOx") by Model Year 1976.[39] In addition, general authority has been conveyed to the EPA Administrator to enforce engine and vehicle standards, through issuance of a certificate of conformity and sale or lease of a vehicle was prohibited unless a vehicle or engine was "covered" by such a certificate.[40] The 1970 Act also provided for specific monetary penalties for non-compliance with engine and vehicle regulations[41] and included provisions requiring manufacturers to provide emission warranties.[42]

In 1970, Congress also provided EPA, for the first time, with authority to regulate fuels and fuel additives.[43] Fuels and fuel additives were required to be registered prior to sale and manufacturers were required to provide EPA with name and concentration of additives in fuel as well as the chemical composition of additives[44] EPA was also authorized to require tests to determine the potential public health risks of fuels or additives and the Agency was authorized to promulgate "controls or prohibitions" related to fuels or fuel additives.[45] Finally, EPA was required to study air pollutants from aircraft and to propose emission standards applicable to "any air pollutant from any class or classes of aircraft or aircraft engines."[46]

In 1977, Congress directed EPA to prescribe regulations to control CO, HC and NOx from heavy-duty vehicles or engines manufactured during and after Model Year 1979.[47] With regard to CO and HC, a 90 percent reduction was required by 1983.[48] Additional authority was provided to regulate motorcycles.[49] Significantly, EPA was also directed to study the effects on health and welfare of particulate matter ("PM") emissions from motor vehicles and engines.[50] In 1990, as part of a broad rewrite of the Clean Air Act, Congress addressed *nonroad engines and vehicles* by requiring a study of emissions from such vehicles and authorized the EPA to set standards for CO, NOx and VOC.[51] A separate program was established for locomotives.[52]

With regard to fuels, EPA promulgated various regulations during the 1970s and 1980s, including controls on lead and other fuel additives, but the 1990 Amendments made it unlawful to sell fuel for use in motor vehicles containing lead or lead additives.[53] The amendments also required EPA to promulgate regulations to control evaporative emissions (volatility) from gasoline-fueled vehicles as well as to promulgate regulations for the control or air toxics.[54] The reformulated gasoline ("RFG") program[55] was also added to the Clean Air Act in 1990 and remains applicable to 9 large metropolitan areas having high ozone design values. The 1990 Amendments additionally enacted an oxygenated fuels program requiring specific oxygenated blends to be sold in certain areas to address the formation of CO.[56] Most recently, Congress amended the Clean Air Act in 2005 and 2007 to establish the renewable fuels program ("RFS") requiring that levels of renewable fuel be added to transportation fuel sold in the United States, starting in 2006.[57] This program included statutory levels from 2006 to 2022 for various renewable fuels; after 2023, EPA is to promulgate regulations based on specified criteria.

As can readily be seen from the history outlined above, the control of mobile source emissions has been a decades-long endeavor, involving complex issues concerning the control of emissions from vehicles and engines and related issues involving fuels and fuel additives. EPA, has promulgated numerous regulations (outlined in more detail below) that considered the impact of vehicles and engines together with fuel while utilizing flexible implementation methods, backed up by extensive testing, certification, recordkeeping, and reporting requirements. These efforts have resulted in quantifiable gains in air quality while also responding to real world conditions, including the manufacturing and market structure for engine and vehicle production and sales, the fuel blending and distribution process and the need to

ensure that vehicles and engines meet emission standards not only when manufactured but through their entire useful lives.

Successes

At a high level of analysis, EPA's programs to control mobile source emissions have been comprehensive and successful. EPA's various mobile source programs have far exceeded the original statutory goals that Congress specified in 1970. With regard to "conventional" air pollutants, "compared to 1970 vehicle models, new cars, SUVs, and pickup trucks are roughly 99 percent cleaner for common pollutants (hydrocarbons, carbon monoxide, nitrogen oxides and particle emissions). New heavy-duty trucks and buses are roughly 99 percent cleaner than 1970 models."[58]

In 2013, EPA estimated the combined benefits from then-existing mobile source programs in terms of emission reductions, costs, and projected benefits:

Table 3. Benefits from Mobile Source Programs, 2013

	Light Duty Tier 2	Heavy Duty 2007	Nonroad Diesel Tier 4	Locomotive & Marine Diesel	Ocean Vessel Strategy
NOx (short tons)	2,800,000	2,600,000	738,000	795,000	1,200,000
PM2.5 (short tons)	36,000	109,000	129,000	27,000	143,000
VOC (short tons)	401,000	115,000	34,000	43,000	0
SOx (short tons)	281,000	142,000	376,000	0	1,300,000
Total Cost (billions)	$5.3	$4.2	$1.7	$0.7	$3.1
Total Monetized Benefits (billions)	$25	$70	$80	$11	$110
Avoided Premature Mortality	4,300	8,300	12,000	1,400	13,000
Avoided Hospital Admissions	3,000	7,100	8,900	870	12,400
Avoided Lost Workdays	700,000	1,500,000	1,000,000	120,000	1,400,000

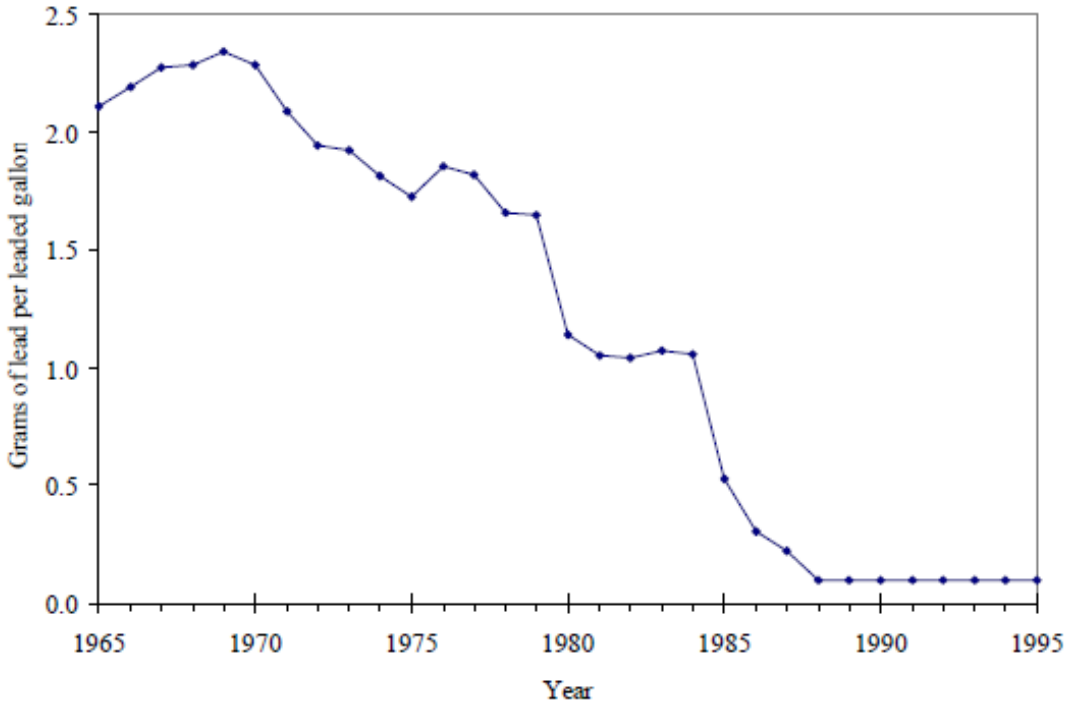
Specific accomplishments of the mobile source program are outlined in the sections below.

1. Phaseout of Lead in Gasoline

One lasting successes of the CAA mobile source program occurred with respect to the phaseout of lead in gasoline. Through a series of regulatory actions involving both fuel and vehicles, lead levels in gasoline began to decline in the 1970s before reaching an approximate 99% phaseout level by the late 1980s, with lead in gasoline being virtually eliminated in the mid-1990s.[59] These reduction occurred both through requiring the production of "unleaded gasoline" to avoid destruction of the emission control system in

new motor vehicles equipped with catalytic converters and through the resulting fleet-turnover of vehicles that required unleaded gasoline.

Figure 4. Lead Content in Leaded Gasoline (U.S. Average)



This reduction in lead in gasoline was reflected in a 98% reduction of U.S. children 1-5 years of age with elevated blood levels of lead.[60] In addition, EPA also estimated that reduced lead levels would reduce the occurrence of hypertension, heart attacks, strokes and deals among males 40-59.[61] Estimated net benefits ranged from 1.1 to 6.5 billion per year in 1988.[62]

2. EPA Standards for Light Duty Vehicles (Conventional Air Pollutants)

As indicated in the overview, the 1970 Act directed specific emission level phase out levels for light duty vehicles. These were supplemented through additional provisions contained in the 1977 Clean Air Act Amendments as well as other legislative actions in 1979 and 1981 to direct the stringency of these emission limits. In 2000, using its general authority under CAA §202(a), EPA promulgated "Tier 2" standards to reduce the emissions of NOx and PM from new passenger cars and light duty trucks starting in 2004 and for heavier vehicles in 2008.[63] In addition, this rulemaking also capped the amount of sulfur allowed in gasoline in order to enable the use and durability of more advanced emission control systems. EPA estimated the regulations would result in substantial benefits in terms of avoidance of premature deaths and reduced hospitalizations as well as welfare benefits related to avoiding crop damage, improving visibility, and decreasing nitrogen deposition.[64]

In 2014, EPA promulgated Tier 3 standards for light- and medium-duty vehicles as well as some heavy-duty vehicles.[65] These standards further reduced allowable vehicle tailpipe emissions as well as set lower sulfur limits for gasoline, beginning in 2017.[66] More stringent requirements related to evaporative

emissions were also included in the final rule. In total emission reductions were estimated to decrease ozone levels across the country by approximately 1 ppb by 2030[67] as well as decrease CO2e emissions from 2.5 to 2.7 million metric tons.[68]

3. EPA Standards for Light Duty Vehicles (GHG Standards)

In 2010, EPA and the National Highway Traffic and Safety Administration ("NHTSA") promulgated the first emission standards that directly controlled GHGs from light duty vehicles.[69] These standards were expanded in 2012, to address light duty vehicles for Model Years 2017-2025.[70] The standards were projected to result in a net reduction in CO_2 emissions of 27 million metric tons ("MMT") carbon dioxide equivalent ("CO_2e") in 2020, increasing to a reduction 569 MMT CO_2e in 2050. Reductions in other GHGs were estimated at 4 MMT CO_2e in 2020 and 47 MMT CO_2e in 2050.[71]

Unlike standards for conventional air pollutants, the GHG standards were not paired with changes to vehicle fuels. Instead, the standards focused on fleetwide g/mile CO_2 emissions as determined with reference to a vehicle's footprint (essentially the area covered between the four wheels of the vehicle). Reductions in CO_2 emissions were primarily based on an increase in the fuel economy of vehicles that were projected to be sold; other GHG reductions were estimated based on changes in air conditioner efficiency and refrigerants as well as relatively small reductions in methane and nitrous oxide.

4. EPA Standards for Medium- and Heavy-Duty Vehicles (Conventional Standards)

EPA promulgated standards for NMHC+NOx to be applied to heavy-duty compression ignition (diesel) engines and urban buses starting in 1974. Since that time, standards have been progressively tightened. In the early 1980s, EPA published notices and proposals to further control NOx and PM from heavy-duty engines, in accordance with the 1977 Clean Air Act Amendments. Final rules were adopted in 1985, following litigation.[72] These rules applied NOx standards to both gasoline and diesel-fuel heavy duty engines and established the first PM controls for this sector. Other adjustments to these rules were subsequently adopted.

Major additional requirements applying to onroad heavy duty vehicles, still in effect today, were adopted by EPA in early 2001.[73] These standards were designed to be implemented within the 2007 to 2010 timeframe and were dependent on rules providing for the production of ultra-low sulfur (15 ppm) diesel rule in order to allow vehicles to attain a 0.2 g/bhp-hr limit on NOx. The 97% reduction in the sulfur content (compared with 500 ppm fuel previously used) was designed to allow diesel vehicles "to achieve gasoline-like exhaust emission levels."[74] Emission reductions by 2030 were projected at 2.6 million tons of NOx, 115,000 tons of NMHC and 109,000 tons of PM.[75]

5. EPA Standards for Medium- and Heavy-Duty Vehicles (GHG Standards)

In 2011, EPA in coordination with NHTSA promulgated the first emission standards that directly controlled GHGs from medium- and heavy-duty vehicles.[76] These standards were expanded in 2016 to address medium- and heavy-duty vehicles through Model Year 2027.[77]

The 2011 standards, known as Phase 1, largely relied on existing engine emission testing protocols to achieve compliance with new CO_2 grams per ton-mile (gCO_2/ton-mile) standard. Standards also applied to hydrofluorocarbons from air conditioning systems and also referenced existing N_2O and methane

standards.[78] To address the unique requirements of this sector, which are almost universally commercial vehicles designed for multiple end uses, standards separately applied to combination tractors, vocational vehicles and heavy-duty pickups and vans, with subcategories for various types of these vehicles. In addition to engine testing, the rule also incorporated use of the Greenhouse gas Emissions Model ("GEM") to simulate the emission impact of various vehicle features.

The 2016 standards, known as Phase 2, essentially built upon the regulatory structure developed for the Phase 1 rules, relying on engine testing and the GEM model for compliance. Additionally, however, the Phase 2 rule promulgated standards that applied to certain trailers used in combination with heavy-duty tractors.[79] Compliance dates for the trailer provisions of the Phase 2 rule, however, are currently stayed due to ongoing litigation.[80] Projected benefits in reduced CO_2 emissions and improved fuel consumption vary with respect to the type of vehicle involved, but EPA estimated that total vehicle CO_2 reductions from Phase 1 could represent approximately 10% for both downstream and upstream emissions versus baseline in 2030[81] with additional HFC reductions. For the Phase 2 rules, EPA estimated that CO_2 reductions would range from a few percent (compared with baseline) up to a 24 percent improvement in some vehicles.[82]

6. EPA Standards for Nonroad Vehicles & Equipment

Following enactment of the 1990 Clean Air Act Amendments, EPA promulgated the first standards for nonroad diesel engines over 50 horsepower (hp) in 1994, to be phased in from 1996 to 2000.[83] These standards applied to CO, HC, PM and NOx and emission reductions of 27% were forecast by 2010. 1998 standards extended EPA regulations to equipment under 50 hp, while creating "Tier 2" and "Tier 3" standards for all equipment, phased in with regard to the size of engine involved between 2000 and 2008.[84] This rule also extended standards to engines used in smaller (below 50 hp) marine applications. In general, the standards extended relatively the same level of control to nonroad engines as then applied to heavy-duty onroad vehicles.

In 2004, EPA promulgated Tier 4 emission standards which contained substantially more stringent standards for PM and NOx.[85] Since the standards utilized new emission control equipment, they were coordinated with stricter standards for diesel sulfur, implementing a 15 part per million ("ppm") sulfur standard in 2010 for nonroad vehicles. EPA projected that the rules would reduce annual emissions of NOx by 738,000 tons and PM by 129,000 by 2030.[86] Similar to previous rules, these standards were phased in with regard to engine size and allowed for flexibility mechanisms such as averaging, banking, and trading ("ABT") and the Transitional Program for Equipment Manufacturers ("TPEM"). Separately, EPA has also promulgated regulations for nonroad spark-ignition engines (engines that use gasoline) that cover certain marine engines and small engines below 19 kilowatts ("kw") in size.[87]

7. EPA Standards for Locomotives

EPA promulgated standards applying to manufacturers and remanufacturers of new locomotives and new locomotive engines in 1998.[88] The standards applied to NOx, HC, CO, and PM and at the time the rule was promulgated, EPA projected that the NOx standards would eventually result in a 60% reduction in such emissions. EPA subsequently promulgated additional standards for locomotives in 2008 that took effect in 2015.[89] These programs were based, in part, on the development of emission control technology that had been successfully applied to the onroad and other nonroad sectors, and EPA considered that the

2008 rule completed EPA clean diesel rules for all major diesel sectors, requiring the use of advanced technology.[90] In addition to applying to new engines and equipment, the rules required upgrading of existing equipment when engines are remanufactured. In general, locomotives present unique challenges due to their size, operational characteristics, and long useful life periods. States are also preempted from adopting or enforcing standards or other requirements related to the control of emissions from new locomotives and new locomotive engines.[91]

8. EPA Standards for Marine Vessels

EPA has adopted a series of emission standards for marine diesel engines over 37 kilowatts (50 hp). EPA first regulated Category 1 and 2 commercial marine diesel engines in 1999.[92] These standards set levels to control NOx, HC, PM, and CO emissions. EPA then took action to regulate "recreational" engines in 2002, applying essentially the same standards to these engines as already applied to engines used in commercial vessels.[93] Additional standards were promulgated in 2003, extending emission controls to much larger ocean-going vessels.[94] EPA further extended these standards in 2010 by harmonizing U.S. standards with standards adopted by Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL Annex VI).[95] The latter standards are projected to result in a 80 percent reduction in NOx emissions over time and were coordinated with lower sulfur diesel standards.[96] In addition, the rule defined emission control areas ("ECAs") off the U.S. coastline to ensure that both domestic and foreign-flagged vessels meet the rule's NOx standards when operating within 200 nautical miles off most U.S. coasts.[97]

9. EPA Standards for Aircraft

In late 2020, the EPA Administrator signed the first ever GHG standards applying to certain classes of engines used in civilian subsonic jets and larger propeller-driven airplanes. The rules were published in the Federal Register in January 2021.[98] The standards rely on international standards developed by the International Civil Aviation Organization, which became applicable to global aviation in January 2020 and are phased in for new and existing aircraft types.

10. Fuel and Fuel Additive Standards

As noted above, in many cases EPA has coordinated the implementation of new standards applying to engines, vehicles and equipment with new fuel standards designed to accommodate emission control equipment. This has occurred particularly with regard to sulfur levels in gasoline and diesel, but other fuel parameters (such as volatility) can impact vehicle emissions, including emissions from the fuel tank and other components when the vehicle is not in operation. EPA has also promulgated extensive regulations to ensure that fuel standards are met, including for the certification and reporting of fuel "batches" and requirements for product transfer documents that accompany fuel from the time it is produced to its sale at retail outlets. Extensive testing and reporting of fuel quality is also required.

This report will not attempt to detail the full extent of fuel and fuel additive regulations promulgated by EPA since 1970, including their timing and sequencing but will focus on several major areas of EPA activity using the authority of the Clean Air Act. As noted in the overview section, Congress has amended Clean Air Act section 211 on several occasions since 1970 to require that EPA implement specific fuel programs, such as for oxygenated gasoline and renewable fuels. But the following efforts could be

considered the major categories where EPA has successfully used fuel regulations to improve air quality over the last 50 years:

10.1. **Fuel Volatility Regulations:** EPA first promulgated regulations in 1989 to place limits on the volatility of gasoline that varied by the area of the country and months involved.[99] These regulations have subsequently been revised, but they are designed to inhibit the formation of ozone during "summertime" periods when both temperature and daylight hours help to contribute to ozone formation. Certain areas are subject to lower Reid Vapor Pressure ("RVP") requirements than other areas and states are allowed, within limits, to prescribe specific limits that vary from federal standards if needed to address air quality issues.[100]

10.2. **Reformulated Gasoline:** Following enactment of the 1990 Amendments, EPA promulgated RFG regulations, implemented in two phases in 1995 and 2000.[101] As noted above, the RFG program applies in statutorily designated areas, and requires that certain standards apply to gasoline (originally, a 2.0 percent oxygenate level, a 1.0 volume cap on benzene, prohibition on heavy metals) and that gasoline meet certain performance standards (*e.g.*, no net increase in NOx emissions). EPA regulations also prohibit non-RFG gasoline from "backsliding" due to implementation of the RFG program.

10.3. **Mobile Source Air Toxics:** EPA first promulgated standards to control hazardous air pollutants from mobile sources in 2007.[102] These standards combined controls on gasoline, passenger vehicles and portable fuel containers to reduce benzene emissions and other hazardous air pollutants from vehicle exhaust. The regulations also limited the benzene content of gasoline to an average content of 0.62% with an upper limit of 1.3%. EPA predicted that the controls would result in reductions of multiple air toxics, reducing cancer risk from mobile sources by 37% as well as result in additional reductions in HC and PM emissions.[103] EPA predicted that additional reduction in mobile air toxics would occur as a result of the 2014 Tier 3 rule.[104]

10.4. **Gasoline and Diesel Sulfur Regulations:** As noted elsewhere, EPA took several steps to limit sulfur in gasoline and diesel in conjunction with new engine and vehicle standards. The diesel sulfur standards were promulgated in early 2001, eventually limiting onroad diesel to 15 ppm sulfur.[105] Gasoline sulfur limits were initially set at 30 ppm, phased in through 2006[106] and then lowered to 10 ppm in the Tier 3 Rule.[107] In both cases, large immediate reductions in NOx were predicted to result from the rules along with additional reductions in air toxics, VOC and $PM_{2.5.}$

10.5. **Renewable Fuel Standard:** Congress amended the Clean Air Act in 2005 and 2007 to include annual requirements for the use of renewable fuel in transportation fuel.[108] Starting in 2006, gasoline was required to include renewable fuel, while biomass-based diesel and cellulosic biofuel were allowed to be included in the program. After amendments were adopted in 2007 as part of the Energy Independence and Security Act, volumes for four different types of renewable fuel were specified and statutory volumes specified through 2022 for three of the fuels.[109] In 2023 and later years, EPA is to establish RFS requirements after evaluating statutory criteria.

Opportunities

Various perspectives on the opportunities for additional criteria and GHG reductions from mobile sources have been expressed. Some commenters cite climate change as most important future focus of mobile

source programs, with associated challenges to reduce lifecycle emissions of GHGs through various technological means, including opportunities for vehicle electrification. This perspective would seek to eliminate liquid fuels in favor of emphasizing conversion to all electric fleets for most or all personal and commercial vehicles.

Other commenters cited the nexus between mobile source programs and attainment of NAAQS as well as concerns regarding air toxics. From this perspective, there is the opportunity to make additional gains in local air quality through additional standards, programs to "changeout" of older existing equipment (such as the Diesel Emissions Reduction Act) and other efforts. From this perspective, improved emission performance of existing and new vehicles might be emphasized in the near term as a more cost-effective means of achieving air quality goals, not in lieu of lowering GHG emissions through existing standards that are applicable through the middle part of the 2020s, but in conjunction with such programs to achieve both criteria and GHG emission reductions over a longer timeframe.

In this regard, EPA published an Advance Notice of Proposed Rulemaking for new heavy-duty engine standards in January 2020,[110] but to date the Agency has not proceeded to the proposed rule stage despite internal work on this proposal dating back several years. And while EPA announced last year that it expected a proposed rule in early 2021, the Agency now indicates that such a rulemaking is a "long-term" action. This raises the prospect that the opportunity to achieve greater NOx reductions affecting attainment of ozone standards could be delayed.

Other views have been expressed concerning how EPA standards and programs could better serve to incentivize private sector investment, *e.g.*, through recognition of 'early adopters." In the past, EPA has utilized incentives within mobile source programs to provide for additional credits or the ability to earn credits as against a future standard. Such programs offer the opportunity to harness private sector investment and spur the development of technologies which could eventually have wide application within vehicle fleets.

Additional opportunities lie with respect to testing and compliance over useful life periods. In recent years, EPA has stepped up enforcement with regard to "defeat devices," elevating this concern to a National Compliance Initiative. EPA also rewrote 40-year-old guidance regarding tampering.[111] But given the prevalence of these issues, a reasonable opportunity would lie for additional efforts to review certification testing (including durability) as well as in-use testing. Gains have been made with respect to portable emission monitoring equipment and states have pioneered other efforts, but fundamentally, if emission performance cannot be maintained over time, EPA and state projections concerning modeled attainment will be jeopardized and attainment of air quality standards made more difficult.

In this regard, technology may offer additional opportunities with respect to vehicle inspection and maintenance ("I/M") programs. CAAAC is well aware of the difficulties experienced with past I/M efforts, particularly with respect to requirements imposed during the 1990s. But technology has advanced, allowing for potential options may offer increased efficacy along with less burdensome requirements for state programs.

Finally, other opportunities lie in this area related to environmental justice and social equity issues, *e.g.*, with regard to access for all socio-economic levels to new technology and related infrastructure. Consideration of these concerns may occur both during initial review of problem identification and policy options as well any subsequent regulatory process.

Given the diversity of views across all issues, this report seeks to identify underlying issues with utilization of the Clean Air Act to continue to progress already made in the reduction of mobile source emissions.

Future Challenges

The 1970 Clean Air Act provided EPA with authority to address emissions from mobile sources, including engines, vehicles, and fuels. But as indicated above, in several instances since that time, Congress has amended the Act to specifically require various programs. For example, the 1990 Amendments directed the promulgation of new standards for light duty vehicles, added a new subsection for mobile air toxics and included the RFG and wintertime oxygenate programs. One common denominator in these enactments following the 1970 Clean Air Act was that Congress sought to address specific issues related to engines, vehicles, and fuels. For example, the RFG program was targeted at large urban areas with high ozone levels while the wintertime oxygenate program was designed to address CO. The RFS program, enacted in 2005 and expanded in 2007, was designed to increase the use of renewable fuel in transportation fuel as measured by lifecycle impact on GHGs.

In terms of the CAAAC's review, it is clear that EPA has authority to address greenhouse gases from mobile sources under Clean Air Act section 202, but the precise boundaries of this authority are not yet defined. EPA may promulgate standards "applicable to the emission of any air pollutant from any class or classes of new motor vehicles or new motor vehicle engines" after considering several factors.[112] EPA also has authority to require the use of renewable fuels. But it is far less clear what authority EPA possesses in the area of any fueling (or charging) infrastructure that might be necessary to accommodate different types of vehicles, such as zero emission vehicles, that have been advocated to address climate change.

In addition, an issue raised during the discussion of EPA's authority noted the differences between EPA's authority to regulate air emissions and NHTSA's authority to address fuel efficiency and whether such authorities could be "decoupled." In prior rulemakings, EPA has sought to coordinate its standards with NHTSA in order to advance "one national program."

While it may in some cases be strategically advantageous for EPA to not define precise limits on its statutory authority – the issue of climate change was described by some CAAAC members as constituting an existential threat. Therefore, it would be advantageous for EPA to define the extent of its Clean Air Act authority to mandate that certain engine and vehicle technologies be utilized, versus setting standards that are technologically neutral. This would give the public and industry a clear understanding of the extent to which EPA can utilize its authority to reduce carbon emissions from engines and vehicles.

This is not an academic question. As noted elsewhere in this report, litigation regarding issues of the extent of EPA's authority with regard to stationary sources under Clean Air Act section 111 has effectively delayed standards applicable to electric power generating units for a decade and litigation in this area continues. Thus, on the whole, EPA should evaluate whether it would be preferable in terms of public policy and long-term objectives regarding climate change to assess its authority over greenhouse gas emissions from mobile sources upfront. Issues that could be explored include the following:

Recommendations

1. Extent of Clean Air Act Authority and Options Available Under that Authority

1.1. EPA should review its available authority, or lack thereof, to mandate the sale of specific vehicle types, *e.g.*, electric or hydrogen vehicles, versus set standards similar to those adopted in the past that are based on projections of available technology, costs, and potential market adoption of various approaches to controlling vehicle emissions. This should not remain an open question, addressed only in the context of individual rulemaking, but should be considered a threshold issue by the Agency for which public discourse is necessary. Specifically:

1.1.1. If EPA considers it has such authority, what limits, if any, would apply?

1.1.2. If EPA considers it lacks sufficient authority, what legislative authority would EPA or other departments or agencies of the federal government require?

1.2. EPA should also define its authority under the Clean Air Act, if any, to address related vehicle infrastructure issues associated with greater adoption of electric, hydrogen or other alternative-fueled vehicles. Again, such work should precede and inform the public debate on these issues, rather than be explored subsequent to the allocation of resources for such efforts. Issues that should be analyzed include:

1.2.1. How EPA will seek to avoid picking technological "winners" and "losers" when utilizing its authority under the Clean Air Act.

1.2.2. What the relevant sequencing of any public investments may be in terms of the availability of products produced by the private sector.

1.2.3. The relative efficacy of incentives versus mandates for infrastructure investment and the likelihood and extent of private sector investment.

1.3. EPA should develop the necessary analytical infrastructure to more precisely assess the relative impact of different vehicle types on generation of greenhouse gases.

1.3.1. Additional attention should be paid to full lifecycle GHG assessments of different options, including any necessary related infrastructure.

1.3.2. The Agency needs to address how it will assess the potential costs and benefits of alternative technologies with the costs and benefits that may be associated with its previous approach emphasizing increased fuel efficiency. This assessment should be done over a range of different timescales, *e.g.*, 2020-2030, 2030-2040.1.3.3 Concurrently, EPA should address environmental justice issues associated with access to new technology vehicles and infrastructure. What authority would be available to EPA, if any, with respect to the location and "affordability" of new technology/infrastructure?

1.4. The hallmark of EPA's motor vehicle regulations has been the use of compliance flexibility through various mechanisms, including emission credits and ABT. These mechanisms have been used, along with incentives for different technologies, within the light-, medium- and heavy-duty greenhouse gas rules that have been promulgated. How can EPA utilize this past experience as it approaches new rulemakings?

1.5. How will EPA seek to balance mobile source issues versus issues related to the regulation of other sources of greenhouse gases under the Clean Air Act? What common metrics are available

and appropriate for this purpose and what are the analytical limits, if any, of existing cost/benefit mechanisms? (*See* 2.5.1-2.5.3 below)

2. Addressing Local, Regional and Global Air Quality Issues: As noted extensively above, EPA has promulgated Title II regulations to address numerous air quality issues, including NAAQS attainment, reduction in air toxics and reduction in the emission of ozone depleting substances. As reductions from stationary and other sources have been implemented, the overall contribution of mobile sources and stationary sources to air quality issues has shifted over time. In addition, the relative contributions of different sources will vary from area to area. An evaluation of 17 mobile source sectors to ambient ozone and PM levels across the United States indicated summertime ozone contributions of between 2 and 5 ppb (found largely in the Southeast) and annual average $PM_{2.5}$ concentrations of between 0.5 and 0.9 ug/m3.[113] EPA should evaluate several areas:

   2.1. How can EPA effectively balance the needs to attain local and regional air quality goals with the global issues inherent in addressing climate change?

   2.2. To what extent do synergies exist, not exist, or potentially produce contradictory outcomes in addressing local and regional air quality versus global climate change?

   2.3. How should EPA balance both short-term and longer-term health risks associated with localized air pollution versus climate change in terms of overall priorities for the mobile source program?

   2.4. How can EPA integrate its programs with other likely investments occurring outside the Clean Air Act by private industry and federal, state, and local programs?

   2.5. Similar to questions posed for greenhouse gas programs, how can EPA best preserve compliance flexibility mechanisms that it has successfully used in engine, vehicle, and fuel programs? For example, mobile source programs have used the following mechanisms that EPA should evaluate for utilization in future programs:

      2.5.1. Staggered implementation deadlines based on technological and economic analysis concerning necessary time periods for developing and deploying requisite technology.

      2.5.2. Incentive programs, e.g., for advanced technologies, innovative technologies, that allow for the generation of credits.

      2.5.3. Compliance flexibility, e.g., the ability to utilize "off-cycle" emission reductions for vehicle certification, ABT programs, fleetwide compliance and scaled requirements based on vehicle size (light duty programs) and vehicle type and utilization (medium- and heavy-duty programs).

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[34] 42 U.S.C. §1857a(a). 69 Stat. 322, ch. 360 §1 (July 14, 1955). Congress authorized $5 million for such research and expressed a policy "to preserve and protect he primary responsibilities and rights of the States and local governments in controlling air pollution, to support and develop methods of abating such pollution, and to provide Federal technical services and financial aid to State and local air pollution control agencies and other public or private agencies . . ." *Id.* at §1857

[35] Pub. Law 88-206, 73 Stat. 646, Sec. 1.

[36] *Id.*, Sec. 6(a). A technical committee was established and report to Congress required on "measures taken toward the regulation of the vehicle exhaust pollution problem and efforts to improve fuels." *Id.*

[37] 81 Stat. 499, Sec. 6. This authority was located within section 202(a) of the Clean Air Act and remains, in substantial form, in law today.
[38] For example, tampering with vehicle emission control systems is prohibited along with the manufacturing or sale of any component that would have a principal effect of bypassing or "defeating" emission control systems. See CAA §203.
[39] *Id.*, CAA §202(b).
[40] *Id.* CAA §203(a)(1).
[41] *Id.* CAA §205.
[42] *Id.* CAA §207.
[43] *Id.* CAA §211.
[44] *Id.* CAA §211(a)-(b).
[45] *Id.* CAA §211(c). States were preempted from prescribing or enforcing controls or prohibitions on fuels or fuel additives for the purposes of emission control, although a waiver process was allowed for the State of California. *See* CAA §211(c)(4).
[46] *Id.* CAA §231. Enforcement of such standards, however, was delegated to the Secretary of Transportation. CAA §232.
[47] Pub. Law 95-95, Sec. 224 (Aug. 7, 1977).
[48] CAA §202(a)(3).
[49] CAA §202(a)(3)(F).
[50] CAA §214(a).
[51] CAA §213. The nonroad engine and vehicle category includes a wide range of vehicles – from mammoth "earth movers" down to lawn and garden equipment.
[52] 213(a)(5). Similar to onroad standards, separate state standards for nonroad engines and equipment were preempted, subject a process for a California waiver for new engines and equipment apart from locomotives, construction, farm or 175 and less horsepower equipment or vehicles.
[53] CAA §211(n).
[54] CAA §211(l).
[55] CAA §211(k).
[56] CAA §211(m).
[57] CAA §211(o).
[58] *See* https://www.epa.gov/transportation-air-pollution-and-climate-change/accomplishments-and-success-air-pollution-transportation.
[59] EPA's first regulations in this area were promulgated in 1973. 38 Fed. Reg. 1,254 (Jan. 10, 1973); 38 Fed. Reg, 33,734 (Dec. 6, 1973). EPA also promulgated a rule in 1996 following enactment of Section 112(n) of the Clean Air Act in 1990, 61 Fed. Reg. 3,832 (Feb 2, 1996). This rule imposed a general prohibition on the sale of any gasoline for use in a motor vehicle containing more than 0.05 grams of lead per gallon. For an analysis of these phasedown steps see "The U.S. Experience with the Phasedown of Lead in Gasoline, Richard Newell and Kristian Rogers, Resources for the Future, June 2003. Today, the only remaining use of lead in gasoline involves aircraft.
[60] Third National Report on Human Exposure to Environmental Chemicals. Centers for Disease Control and Prevention, National Center for Environmental Health; 2005. Publ. No. 05-0570.
[61] Costs and Benefits of Reducing Lead in Gasoline: Final Regulatory Impact Analysis, U.S. EPA 1985.
[62] Resources for Future at 29, citing 1985 EPA supplementary analysis.
[63] 65 Fed. Reg. 6,698 (Feb. 10, 2000).
[64] Regulatory Impact Analysis, EPA420-R-99-023, December 1999 at v.
[65] 79 Fed. Reg. 23,414 (Apr. 28, 2014).
[66] Fleet standards were applied requiring a staged reduction in emissions of non-methane organix gases ("NMOG")+NOx as well as new per-vehicle standards for PM.
[67] Control of Air Pollution from Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Stanards Rinal Rule, Regulatory Impact Analysis at ES-7.
[68] *Id.*
[69] 75 Fed. Reg. 25,324 (May 7, 2010).
[70] 77 Fed. Reg. 62,624 (Oct. 15, 2012).
[71] Regulatory Impact Analysis: Final Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards at 4-133.
[72] 50 Fed. Reg. 10,606 (Mar. 15, 1985).

[73] 66 Fed. Reg. 5,002 (Jan. 18, 2001).
[74] Id.
[75] Id.
[76] 76 Fed. Reg. 57,106 (Sept. 15, 2011).
[77] 81 Fed. Reg. 73,748 (Oct. 25, 2016).
[78] NHTSA promulgated fuel efficiency standards of comparable stringency.
[79] 81 Fed. Reg. at 73,481.
[80] Truck Trailer Manufacturers Association, Inc. v. EPA, No. 16-1430 (D.C. Cir.).
[81] Final Rulemaking to Establish Greenhouse Gas Emission Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles, Regulatory Impact Analysis at 5-13.
[82] Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2, Regulatory Impact Analysis at ES-15.
[83] 59 Fed. Reg. 31,306 (June 17, 1994).
[84] 63 Fed. Reg. 56,968 (Oct. 23, 1998).
[85] 69 Fed. Reg. 38,958 (June 29, 2004).
[86] Id.
[87] 60 Fed. Reg. 34,581 (July 3, 1995); 64 Fed. Reg. 24,268 (Apr. 25, 2000); 73 Fed. Reg. 59,034 (Oct. 8, 2008).
[88] 63 Fed. Reg. 18,978 (Apr. 16, 1998).
[89] 73 Fed. Reg. 37,096 (June 30, 2008).
[90] Id. at 37, 097.
[91] 40 C.F.R. §1074.12
[92] 64 Fed. Reg. 73,300 (Dec. 29, 1999).
[93] 67 Fed. Reg. 68,242 (Nov. 8, 2002).
[94] These standards applied to Category 3 marine diesel engines, or ocean-going vessels such as container ships, tankers, bulk carriers and cruise ships.
[95] 83 Fed. Reg. 22,896 (Apr. 30, 2010).
[96] EPA applied a 1,000 ppm sulfur limit to diesel fuel used in these vessels in order to displace much higher sulfur levels contained in bunker fuel.
[97] *See* 83 Fed. Reg. at 22,923.
[98] Control of Air Pollution from Airplanes and Airplane Engines: GHG Emission Standards and Test Procedures, 86 Fed. Reg. 2,136 (January 11, 2021).
[99] 54 Fed. Reg. 11,868 (Mar. 22, 1989).
[100] 42 U.S.C. §7545(c)(4)(C).
[101] 59 Fed. Reg. 7,716 (Feb. 16, 1994).
[102] 72 Fed. Reg. 8,428 (Feb. 26, 2007).
[103] *Id.* at 8,430.
[104] 81 Fed. Reg. at 23,624.
[105] 70 Fed. Reg. 70,498.
[106] 65 Fed. Reg. 6,698 (Feb. 10, 2000).
[107] 79 Fed. Reg. 23,414 (Apr. 28, 2014).
[108] Pub.L. 109-58 (Aug. 8, 2005), Pub.L. 110-140 (Dec. 19, 2007); 42 U.S.C. §7545(o).
[109] Specific volume requirements for biomass-based diesel ended in 2012.
[110] 85 Fed. Reg. 3,306 (January 21, 2020).
[111] EPA Tampering Policy: The EPA Enforcement Policy on Vehicle and Engine Tampering and Aftermarket Defeat Devices under the Clean Air Act, Nov. 23, 2020.
[112] *See*, e.g., 42 U.S.C. §7521(a)(2), (a)(3).
[113] Mobile Sector Source Apportionment – Air Quality and Benefits Per Ton, Zawacki, M., Baker, K.R., Phillips, s., Davidson, K, Wolfe, P., 2018.

Developing and Utilizing High Quality Data

Overview

The study of air quality is essential to maintain human health and the environment. The ability to measure air pollution can provide information that can help in understanding the sources of it and implementing measures to reduce or eliminate it. Verified air quality data meeting regulatory protocols is also central to the operation of the air quality management systems established by the enactment of the 1970 Clean Air Act. Air quality data determines the attainment status of an area as well as the requirements of the Clean Air Act that apply to states and emission sources.

Understanding air quality and its effect on human health and the environment requires the development and maintenance of high-quality data. This data allows for a deep understanding of the sources, formation, and impacts of air pollution. Air quality data also allows for the projections or forecasting of related impacts. One example of this is the air quality index that provides citizens with vital information about the air quality in their community.

EPA provides an important role in the collection and maintenance of air quality data. EPA regulations define data that is utilized for determining attainment status and for measuring source compliance with various Clean Air Act programs. Air quality data is also utilized to support assessment of the health impacts of various pollutants as well as other impacts on the environment (e.g., deposition to land and water).

Air quality data also is central to risk communication. For example, EPA has created and maintains AirNow, which provides access to outdoor air quality data collected from state, local, and tribal monitoring agencies across the United States. EPA publishes air emissions factors and compiles emissions inventories submitted by states every three years. This shows which sources emit how much pollution and support air quality modeling efforts. EPA publishes an electronic reporting tool that sources can use to report stationary source emissions sampling test data to regulatory agencies.

States and EPA also conduct air pollution deposition monitoring to assess progress under the Clean Air Act (e.g., with regard to acid rain and “nitrification”). This data also supports publication of EPA’s periodic trends reports on air quality, information on air emissions in the United States over time represents one of the best and longest-running environmental trends assessments in the world. For greenhouse gases, EPA’s Greenhouse Gas Reporting Program, in operation now for over a decade, provides a detailed understanding of where greenhouse gas emissions are emitted and in what quantities. This information will improve the ability of policymakers and the public to make informed, policy, business, and regulatory decisions.

Opportunities

1. New sensor technology to measure air pollution as well as remote sensing technology offer the opportunity, with EPA guidance on appropriate use, to be integrated with ambient monitoring networks to provide for a more robust monitoring network across the country.

2. New sensor technology as well as remote sensing technology can be used to validate models, support emissions inventories, and provide access to information about air quality where monitoring data acquired through other methods, such as Federal Reference monitors, is not available.

3. EPA should explore the availability of such advanced technologies for measurement of air pollution and whether such can be incorporated into NAAQS reviews to develop health and welfare standards. For example, EPA could consider or seek out epidemiological studies that use new sensor data for different pollutants and evaluate whether they could be utilized during the NAAQS review process.

4. EPA should also evaluate whether it could use data from sensors in conjunction with its existing air quality monitoring and modeling system to estimate exposure in unmonitored areas.

5. The EPA's required monitoring five-year network assessments and review of annual monitoring network plans can be better used to collect the highest-priority data, especially with respect to support environmental justice considerations. For example, EPA could require explicit consideration of establishment of an adequate state/tribe/local government monitoring network to monitor ambient air quality in areas that score high on EPA's EJ Screen tool and prioritize the siting of monitoring stations in these areas or revise its network regulations to require a minimum number of EJ-based sites.

6. Accessibility to data has increased over the years (i.e., AirNow, GHG emissions, NEI, Clean Air Markets Division, etc.) and can continue to grow. But there is further opportunity here for data integration and data translation in order to increase the public's understanding of this data and its meaning. Considerable room for improvement exists in communicating with the public in a meaningful way.

7. Advances in technology and assessment techniques such as refined surveys can allow for development of more precise emission factors to aid in development of emissions inventories and provide the most up-to-date information to facilities who rely on this data.

Successes

1. EPA's National Emissions Inventory (NEI) provides a comprehensive picture of the emissions from all sources across the country and is a critical tool for understanding emissions and their relationship with ambient air quality.

2. EPA's collection of data on the costs and other logistical considerations for implementing pollution control technologies and other measures provides and important planning tool for states, tribes, local government, and business.

3. Ambient air quality monitoring networks constantly measure and evaluate the status of air quality and provide information to regulators, scientists, industry, and the public. Ambient monitoring data is used to determine where air quality standards are being achieved, assess trends in air quality, and assess the impact of pollution generated by various activities.

4. Stationary source (e.g., businesses, factories, power plants, etc.) emission monitoring and reporting provides data and information from a regulated stationary source, or facility, to demonstration compliance with certain regulatory requirements in Federal or State rules. These emissions inventories are an important tool for air quality planning efforts and scientific research on air quality.

Additionally, stationary source monitoring provides useful information to the facility operator about the performance of the facility so corrective action can be taken, where necessary.

5. Emerging low-cost sensor monitoring allows for greater access to data that can be used to locate pollution hotspots, identify sources of pollution, supplement fixed-site monitoring data, measure personal exposure to pollutants, educate, and enhance air quality awareness.
6. Advances in remote sensing technology provide information about spatial variation in exposure patterns, allow for identification of hot spots, and provide data used to enhance and refine meteorological models.
7. Scientific research efforts have led to major advances in air quality issues that have improved understanding of air pollution such as formation, behavior, chemistry including secondary reactions, allowed for development of emissions inventories, created new methods for detecting air pollution, and refined models used to predict air pollution.
8. Advances in data collection and storage, as well as methods for display and sharing have reduced burdens and increased accessibility of air quality data to the public.

Future Challenges

1. Much of the funding for the ambient monitoring networks operated by states, tribes, and local governments is provided by the Federal Government through the section 105 grant program, but funding levels have remained at stagnant levels for many years. This has resulted in agencies relying on outdated equipment and not being able to afford efficiency updates (i.e., remote operations of networks/instrumentation).
2. While newer technologies are available to aid in the development of NAAQS, they are often not well funded and appropriate data collection systems are not made available. EPA explicitly pointed to lack of available monitoring data for ultrafine particles and speciated $PM_{2.5}$ as factors constraining their ability to conduct health assessments for different types of PM during the most recent PM NAAQS review. Where states, tribes, and local governments expended extra effort to develop systems, EPA has not always used the data for NAAQS reviews.
3. There is greater access to instrumentation and data that can aid in air pollution detection, measurement, and communication, but its capabilities and use are undefined from a regulatory perspective. For example, satellite air pollution measurements are widely recognized; however, EPA has not developed a comprehensive policy regarding how they can be used in various contexts, e.g., in relation to regulatory uses and required monitoring.
4. New technologies have been developed that can greatly enhance and aid compliance reviews (i.e., infrared cameras and other optical systems, fenceline monitoring with sensors), but they are often too expensive for agencies to utilize and not funded. Additionally, many agencies do not have appropriate understanding of the ability to use such systems with regard to regulatory compliance or other uses.
5. Many of the emission factors in use are outdated, inaccurate, and may not be appropriate for certain sources of emissions (i.e., natural gas fired dryers, printing operations). This information is needed

for many focus areas including setting priorities for reducing air pollution, rule development, compliance monitoring, compliance assurance, and enforcement.

6. Collecting the data needed for exceptional events demonstrations and assessing the impacts of international emissions and photochemical modeling required for SIPs can be extremely resource-intensive for states, tribes, and local governments.
7. As EPA considers lower NAAQS, it is essential that instrumentation, models, and other tools used to demonstrate attainment with the NAAQS are able to perform at lower levels.

Recommendations

1. Ambient Monitoring

   1.1. **Request More Funding for Monitoring:** EPA should request additional funding from Congress for state/local/tribal monitoring to appropriately consider the cost of funding a modernized monitoring network.

   1.2. **Address NAAQS Monitoring Requirements:** EPA should consider revising monitoring requirements to focus on pollutants for which achieving attainment or maintaining the NAAQS is more challenging. An example of this includes streamlining monitoring for carbon monoxide (CO) and nitrogen dioxide (NO_2), for which the standards are broadly being met.

   1.3. **Increase Funding for Community Monitoring:** EPA should improve and increase funding opportunities to organizations for the purposes of community monitoring, in accordance with monitoring objectives and stated environmental justice goals. EPA must accompany this funding with specific resources on quality assurance of data, as well as comparison to federal regulatory requirements.

   1.4. **Increase Ultrafine and Speciated PM Monitoring:** EPA should fund and then require additional ultrafine and speciated particle monitoring to better characterize the state of particulate attainment. Additionally, EPA should establish data handling procedures to utilize these types of monitoring to support PM NAAQS reviews.

   1.5. **Take Ownership of Expertise in Sensor Technology:** EPA should maintain and expand expertise in sensor technology and continue to develop useful information about performance targets, accuracy, and interpretation of results. The work of the South Coast Air Quality Management District (SCAQMD) is groundbreaking and EPA's "Air Sensor Toolbox" should be expanded to incorporate more sensor information to be a one-stop-shop. This will provide citizens, the regulated community, and air agencies valuable assistance in understanding and utilizing sensor technology.

   1.6. **Improve Understanding of Remote Sensing Measurements:** EPA should partner with researchers to better understand remote sensing measurements, especially satellite air pollution measurements and how they compare to ground based ambient measurements.

   1.7. **Help Document Large-Scale Exceptional Events**: EPA should pro-actively assess the occurrence of larger exceptional events each year, such as large wildfire events, and flag data that might have regulatory significance as potentially affected by an exceptional event.

Consistent with current guidance, EPA should still provide states the opportunity to flag data for consideration as exceptional events, beyond those that EPA may have flagged.

1.8. **Improve Utility of 5-Year Monitoring Network Assessment:** EPA should consistently engage in the 5-year monitoring network assessment process, including developing more guidance to help ensure the assessment is useful across more applications (i.e., environmental justice).

2. Emissions

2.1. **Conduct a Comprehensive Review of Emission Factors:** EPA should undertake a comprehensive review of emission factors and ensure that adequate resources are allocated to periodically update these factors to account for the best available information that accurately reflects emissions from each source, including but not limited to conducting a statistically significant survey or testing of emission sources.

3. Data Integration and Availability

3.1. **Conduct a Comprehensive Review of EPA Databases:** EPA should increase accessibility and function of data and databases. For example, EPA could make certain modeling data available and accessible to the public. EPA could also consider whether certain databases have data that can be layered to provide greater accessibility to information in one location.

3.2. **Expand Integration of Ambient Monitoring Data:** EPA should continue to pursue opportunities for expanding access to data from sensors and integrating it with other monitoring data in order to improve understanding and communication of real-time ambient air quality information (i.e., AirNow Fire and Smoke map).

Tribal

"Mankind needs to move away from our learned habits and embrace new methodologies before we destroy our inheritance."

- Tribal Air Program Professional

Overview

Air quality impacts the estimated 5.7 million people who were identified in the 2010 census as American Indian and Alaska Native (AI/AN). Further, both rural and urban air quality issues impact Tribes: 78 percent of AI/AN live outside of Tribal reservations or lands, while the remaining 22 percent of AI/AN live on trust lands or reservations. The 2010 census also shows that 60 percent of AI/AN live within a metropolitan area.[114]

For thousands of years prior to the colonization of North America, indigenous peoples engaged in resource conservation including land management practices such as cultural burning. Post-colonization, American Indian and Alaska Native Tribes have gradually re-established their role in land and natural resource management[115]. In 1970, when Congress enacted the Clean Air Act (CAA), the federal government assumed a lead role for air pollution and associated public health impacts. Though Tribes were not initially recognized in the 1970 statute, the 1990 Amendments to CAA enabled Tribes to assume authority for air quality management in Indian Country through the Tribal Authority Rule[116] and Treatment as A State. These authorities reflect the U.S. Constitution, which recognizes Indian Tribes as distinct governments with many of the same powers as federal and state governments, such as the ability to regulate their internal affairs, to establish their own form of government, to enact legislation and establish law enforcement and court systems.

The 1990 Clean Air Act Amendments also made Tribes eligible to receive federal funding for environmental programs see, e.g., 42 U.S.C. §§ 7403, 7405, and in the 30 years since, Tribal management and capacity have grown markedly. As of 2021, 85 Tribes operate air quality monitors, 74 Tribes have completed Emissions Inventories, 61 Tribes have non-regulatory Treatment-as-a-State status, 10 Tribes have regulatory Treatment-as-a-State status, and 127 Tribes are funded to manage air quality through either the CAA Section 103 or CAA Section 105 program. As of 2021, there are 15 Tribes that are implementing regulatory or permit programs in Indian country[117]. 7 of those Tribes are implementing Tribal Implementation Plans (TIPs), 2 of the Tribes are managing Title V programs and 6 Tribes have delegation of the Federal Air Rules for Reservations (FARR), a Tribal program in EPA Region X.

Challenges for Tribes include more than 400 major sources sited on Tribal lands; 113 Tribes experiencing non-attainment of one or more National Ambient Air Quality Standards; interstate and trans-boundary air pollution; and the many consequences of climate change. In the last decade, some of the worst wildfires in history took place, particularly in the western US, where all 215 Tribes experienced episodes of "thick density" smoke in the 2019-2020 fire season.[118] In Alaska, where over 40% of federally-recognized Tribes reside, unprecedented wildfires and extreme drought conditions endanger the health and safety of many rural and remote Tribes[119].

Carol A. Kriebs, Chairwoman of the National Tribal Air Association, noted in 2021 that Tribes have been practicing resiliency for thousands of years and will continue to persevere. She adds that with EPA's support, Tribes are committed to protecting air quality for "their people, airsheds and non-human relatives." The US government supported Tribal rights to protect these resource in Executive Order 13175, adopted on November 6, 2000, which states that "The United States recognizes the right of Indian tribes to self-government and supports Tribal sovereignty and self-determination." EO 13175 was reaffirmed by the Biden Administration in the January 26, 2021 Memorandum on Tribal Consultation and Strengthening Nation-to-Nation Relationships.[120]

Chairwoman Kriebs expresses concern and disappointment that federal funding for Tribal air programs has been stagnant or declining for nearly 20 years and that "there are many Tribes that wish to develop air quality programs to improve public health for their communities, but federal grants for new Tribal air programs are difficult to achieve due to the stagnant nature of federal Clean Air Act funding."[121]

Successes

Since its adoption in 1970, the Clean Air Act has measurably improved air quality, yielding important environmental and human health benefits for Tribes. Many Tribes have unique hurdles they must overcome to execute successful CAA programs and those programs typically have direct positive impacts to environmental justice and both Native and Non-Native communities. Successes associated with the Clean Air Act include:

1. Emissions Reductions with Positive Impacts on Tribal Natural Resources and Health

1.1. Sulfur dioxide emissions have dropped in part due to the use of marketable pollution allowances, which in turn cut power plant emissions that contributed to acid rain. Reducing acid rain has reduced the damage to water quality in lakes and streams, and the subsequent harms to fish and wildlife. This protection of fish and wildlife is one way the CAA helps ensure sustainability of treaty-protected Tribal resources. Between the 1989 to 1991 and 2009 to 2011 observation periods, wet deposition of sulfate (which causes acidification) decreased by more than 55 percent on average across the eastern United States.

1.2. Mercury poses a significant health risk for many Tribes. Methylmercury bioaccumulates in the tissues of finfish and shellfish. Many Tribes have much higher rates of fish and shellfish consumption than the non-Indian public. (EPA uses a mean per capita ingestion rate of 20.1 grams/day for the general population, and with Tribal populations, recommends the use of the 99th percentile, or 215.7 grams per day.[122] While there remain areas of high concentrations of mercury, the Clean Air Act has helped accelerate measurable improvements. This success is due in part to the 2011 EPA issuance of the Mercury and Air Toxics Standards (MATS) regulation, which helped reduce toxic air pollutants from coal- and oil-fired power plants. For example, CDC data from 1999-2010 in the National Health and Nutrition Examination Survey (NHANES) found a decline of 34% in blood mercury concentrations in women of childbearing age.

1.3. Reductions in criteria and hazardous air pollutants have reduced Tribal exposures to carcinogenic and mutagenic chemicals detected in flora, fauna, fish and wildlife[123], which many Tribes rely on for their subsistence lifestyle, for cultural and spiritual purposes, and for the beneficial respiratory and cardiovascular health outcomes.

2. Expansion of Tribal Capacity in Air Quality Management

2.1. The number of Tribes with regulatory Treatment-as-a-State (TAS) status has grown from 7 Tribes in 2012 to 11 Tribes in 2020. Tribes with non-regulatory TAS has gone from 34 in 2012 to 60 in 2020. These increases reflect growth in Tribal air quality management, but also in Tribal sovereignty to regulate air quality in partnership with state and local governments. In addition, 7 Tribes have Tribal Implementation Plans, 5 Tribes have Class I Redesignation under the PSD Program, and 2 Tribes Implement Title V Programs. To put this information into context, Tribes own nearly 100 million acres, which represents greater than five percent of the land in the US. 56 million of these acres are in the contiguous U.S., while another 44 million acres are owned by Alaska Natives.[124]

2.2. Tribal implementation of CAA programs has been strengthened through collaboration with Northern Arizona University (NAU), which established the Institute for Tribal Environmental Professionals (ITEP) in 1992. This was a result of the need for Tribal capacity building due to the CAA's implementation of the Tribal Authority Rule and Treatment as A State. ITEP strengthens Tribal capacity and sovereignty in environmental and natural resource management through culturally relevant education, research, partnerships, and policy-based services. Ambient air quality programs provided by ITEP include training, web-based learning, student scholarships, the National Tribal Forum on Air Quality and many other programs that build Tribal capacity.

2.3. In 2009, EPA's Office of Air Quality Planning and Standards adopted the guidance document "Consulting with Indian Tribal Governments", and in doing so, provided a roadmap for the agency to address Clean Air Act issues with Tribes on a government-to-government basis.

2.4. In 2011, EPA promulgated the Review of New Sources and Modifications in Indian Country and in 2014 revised this rule in the form of a Federal Implementation Plan (FIP). This benefitted CAA permitting of air pollution sources in Indian country and helped improve implementation of the minor New Source Review rule. Before the implementation of the Tribal minor NSR, there was no way to permit minor sources in Indian Country, leaving a "hole" in permitting and enforcement.

2.5. The Tribal Air Monitoring Support (TAMS) Center was established in 1999 through a partnership between EPA and the Institute for Tribal Environmental Professionals (ITEP). The TAMS Center is guided by a steering committee that includes Tribal participants from throughout the United States. The technical training center has trained over 1,900 Tribal environmental professionals, representing 298 Tribes.

2.6. The Tribal Authority Rule (TAR) implements the provisions of section 301(d) of the Clean Air Act and authorizes eligible Tribes to implement their own Tribal air programs. The TAR was adopted in 1998 and represents EPA's position that the CAA constitutes a "statutory grant of jurisdictional authority to Tribes" that is consistent with the language of the Act. The TAR enables Tribes to adopt a Tribal Implementation Plan (TIP).

2.7. Other successes include EPA delegations of Title V Operating Permit Program, Tribal participation in Regional Planning Organizations (RPOs) to address visibility and haze, Tribal NSR, and establishment of a Tribal set-aside within the Diesel Emissions Reductions Act (DERA). These have enabled Tribes to fully participate in regulating sources that are located on, or

impact, their lands. A great deal of training and capacity building has taken place, for Tribal environmental staff but also Tribal leadership and legal staff.

Future Challenges and Opportunities

There are a number of crucial areas where the EPA could improve upon its methods of addressing air quality in Indian Country.

1. Air Quality Management Resources

1.1. Insufficient and inconsistent funding for compliance and enforcement: Tribal air programs are an essential contributor to air quality regulation and management. Lack of adequate funding results in insufficient field staff for compliance monitoring and assurance as well as enforcement. This places the onus for inspections or permitting site visits on EPA, yet their regional offices in urban areas are far from the 56.2 million acres[125] of frequently rural reservations. Travel budgets for regional EPA air program staff are historically limited, adding another barrier to their role in on-site air quality enforcement.

1.2. Stagnant funding for Tribal air programs: The US General Accounting Office (GAO) examined environmental funding to Tribes for FY 2014-2019 and concluded that "More Tribes are applying for a stagnant or declining pool of funds – leaving each Tribe with less."[126] Because federal CAA funding has been stagnant, Tribes with existing air quality management programs receive the vast majority of available funds. Consequently, hundreds of Tribes have a difficult time obtaining air program funding, even though they may experience non-attainment or have unclassifiable airsheds. Tribes who do have CAA funding have faced flat funding for many years, limiting their capacity to update their emissions inventories, to purchase new monitors, to develop new quality assurance project plans, or to pursue authorities such as Class I Redesignation, permitting authorities, Tribal Implementation Plan development, or TAS status.

2. Climate Change

2.1. The impacts of wildland fires and intrastate, interstate, and international air pollution transport on the attainment status of Tribal lands are expected to increase in importance. As a result, there is a risk of air quality designations migrating from "attainment" to "non-attainment" due to pollution beyond Tribal control. Because being classified as "non-attainment" will negatively impact Tribal economic development, these events require some relief under the Clean Air Act.

2.2. Exceptional events will become more difficult to address as these events continue to impact air quality designations. Tribes may need supplemental human resources to participate in any revisions to the designations, as well as the forestry and land management policies that contribute to exceptional events, at the local, state, and regional level.

2.3. Ambient and indoor air quality may be impacted by increases in smoke, mold spores, pollens and other pollutants and allergens. Because Tribal housing often lacks whole-house ventilation or HVAC systems, ventilating and filtering the indoor air is a particular challenge for many Tribal households. EPA can provide value by identifying effective and safe technologies for filtering indoor air and by promoting indoor air filtration in grants and cooperative agreements with Tribes.

3. Government to Government Consultation

3.1. EPA's interactions with Tribes are guided by policies, such as the 1984 Indian Policy and the EPA Policy and Federal Policy on Consultation and Coordination[127]. Yet while the agency's actions often reflect these policies, it is not always consistent. President Obama's 2009 Executive Order on Tribal Consultation notes that failure on the part of the federal government to "include the voices of Tribal officials in formulating policy affecting their communities has all too often led to undesirable and, at times, devastating and tragic results."[128]

3.2. Engaging with the National Tribal Air Association is useful but is not direct consultation. Current federal policy is to recognize this sovereignty and to operate on government-to-government basis with Tribes.[129]

3.3. Streamlining of processes, particularly opportunities for comment, challenges Tribes' ability to investigate and provide thorough comments.

4. Air Quality Monitoring Infrastructure

4.1. Aging monitors: The National Tribal Air Association's 2021 Status of Tribal Air Report estimated that half of all air monitors in Indian Country are over ten years old, which means they are approaching the end of their useful life. Financial support is necessary for Tribes to upgrade their air quality monitoring networks. It is noteworthy and disappointing that in 2021, 85 Tribes were operating air monitors, a reduction from 88 in 2020.

4.2. Low-cost sensors: With low-cost monitoring technologies proliferating rapidly (see "Developing and Utilizing High Quality Data section), Tribes can now affordably expand the number and locations of sites for data collection. However, while "citizen science" is valuable, it is not a substitute for regulatory monitoring, and EPA and Tribes cannot rely solely on citizen science to make formal regulatory decisions in Tribal areas.

Recommendations

The following recommendations reflect information that the CAAAC heard from individual Tribal air programs in the process of preparing this report, as well as needs identified by the National Tribal Air Association.

1. Tribal Capacity

1.1. Invest in Tribal Air Quality Management capacity through adequate and consistent funding.

1.2. Provide timely approval of applications for Treatment as a State from Tribes.

1.3. Provide resources for additional Tribes to have their own air quality management programs.

1.4. Encourage Tribes to apply for Tribal authorities, including Class I redesignation.

1.5. Avoid directing Tribes towards "informational monitoring" with low-cost sensors, versus investing in Tribal use of Federal Reference Methods. Tribes should have the prerogative to decide the level of monitoring and data collection in their jurisdictions. This should be observed at both the national and regional level.

1.6. Invest in Tribal regulatory monitoring equipment so that Tribes operate as partners with local, regional, and state air quality agencies.

1.7. Continue to strengthen Tribal ability to set air quality standards for Indian Country, as authorized by the Tribal Authority Rule.[130] This includes requiring upwind state and federal land/air/water managers to consult with Tribes on activities that could exceed standards set by the Tribe or have impacts wherein thresholds have not been set but strong indications of potential harm exist.

1.8. Provide new funding to Tribes to keep pace with the increased amount of work in permitting new stationary sources and to review permits issued by states and EPA.

1.9. Assist Tribes with wildland fire response – monitoring impacts from controlled burns, which are increasingly necessary for decreasing the impact of large fires.

2. Improve Government-to-Government Consultation with Tribes

2.1. EPA should work to ensure meaningful of Government-to-Government Consultation, especially when considering delegating authority to states.

2.2. Tribes are sovereigns and should be provided opportunities for direct consultation with EPA rather than EPA relying only on consultation with the National Tribal Air Association.

2.3. Develop and implement training of new and existing EPA Air staff on the 1984 Indian Policy, the Government-to-Government relationship, and the intent and procedures of Tribal consultation.

3. Special Consideration of Tribal Concerns and Recommendations: Given their status as sovereign entities, EPA should give special consideration to Tribal concerns and policy recommendations on implementation of the Clean Air Act. Tribal governments that provided input to this report made broader recommendations on implementation of the Clean Air Act. These included support for measures to controlling greenhouse gases, reconsideration of the 2020 PM and O_3 NAAQS reviews, review of the cost/benefit and transparency in science rules promulgated in recent years, building the agency's EJ program, and reducing emissions from oil and gas. Many CAAAC members support some or all of these recommendations, while others may not support any of them. Regardless of our own views on these issues, we recognize the special consideration that EPA and other stakeholders owe to Tribal perspectives on overall national air quality policies.

4. Other

4.1. Continue to support diesel emissions reduction grants to Tribes and in support of improvement of air quality in Tribal areas, such as the successful Tribal set-aside in the Diesel Emissions Reduction Act (DERA) program.

4.2. If a Wood Heat Emissions Reduction Act (WHERA) is approved by Congress, the agency should establish a Tribal set-aside in the WHERA program as well, considering the extensive use of wood heat throughout Tribal lands.

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Environmental Justice

Background

This 50th Anniversary report was commissioned to be both retrospective and prospective, highlighting successes and future challenges of the Clean Air Act (CAA). It thus provides an inflection point for all that EPA has accomplished. Yet in celebrating the 50th anniversary of the CAA, it is incumbent that we acknowledge the differential impacts of air quality on communities across the United States.

The purpose of this section is to explicitly acknowledge these disparities, while also highlighting the Clean Air Act's successes and opportunities for bringing about environmental justice. EPA defines Environmental Justice (EJ) as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." The EJ movement arose from disparities in environmental quality among communities of color and low-income communities, with air pollution just one of several pathways of exposures.

An extensive body of scientific literature establishes that black, brown, and indigenous communities in the United States continue to experience some of the worst air quality in the nation, demonstrated across multiple scales and metrics.[131] Disparate exposure to air pollution also varies across income groups, with a higher risk of premature death from fine particle air pollution among low-income communities.[132]

Higher rates of morbidity and mortality within EJ communities are associated with well-documented disparities in air pollution exposures. In their 2020 Review of the National Ambient Air Quality Standards for Particulate Matter, EPA itself references the Integrated Science Assessment (ISA) data, noting: "[t]here is strong evidence demonstrating that black and Hispanic populations, in particular, have higher $PM_{2.5}$ exposures than non-Hispanic white populations" and that "there is consistent evidence across multiple studies demonstrating an increase in risk for nonwhite populations."[133] These disparities, by income, race and ethnicity, were recognized early on by Dr. Robert Bullard, long considered the father of the environmental justice movement. Dr. Bullard observed that, "Whether by conscious design or institutional neglect, communities of color in urban ghettos, in rural 'poverty pockets,' or on economically impoverished Native-American reservations face some of the worst environmental devastation in the nation."[134]

Air pollution, however, is a particularly persistent risk factor in EJ communities. Despite clear and substantial improvements in air quality over the last five decades, the benefits have not accrued equally to all. For example, a 2020 report by Colmer et al. found that concentrations of $PM_{2.5}$ vary spatially. Reviewing 36 years of data, across 8.6 million grid cells with geographic, economic, and demographic data from ~65,000 U.S. census tracts, the researchers illustrated that "differences in $PM_{2.5}$ between more and less polluted areas declined substantially between 1981 and 2016. However, the most polluted census tracts in 1981 remained the most polluted in 2016. The least polluted census tracts in 1981 remained the least polluted in 2016. The most exposed subpopulations in 1981 remained the most exposed in 2016."[135]

The Clean Air Act provides a framework for addressing these disparities. The CAA requires EPA to consider the health impacts of air quality on subpopulations, making it one of the most important pieces of public health legislation in United States history. In addition, the CAA establishes primary National Ambient Air Quality Standards (NAAQS), which go beyond protecting the general population and are intended to protect the health of sensitive populations. They do this by establishing maximum allowable air pollution concentrations that apply nationally, regardless of regional variations in air pollution concentrations. By establishing these limits, the NAAQS have reduced air pollution-related mortality among communities of color. Recent integration of satellite imagery, air quality monitors, and chemical air transport models have demonstrated promising results. Currie et al., 2020, utilized this approach and found that the Clean Air Act has been the single largest contributor to reduction of racial disparities in $PM_{2.5}$ exposure.[136]

From an EJ perspective, NAAQS are also instrumental when areas are designated "nonattainment". The nonattainment designation is based on measured air quality within a designated area in comparison to the design value of the NAAQS. Where multiple monitors are placed within an area consistent with EPA regulations, all monitors generally "count" towards attainment status so that the "worst performing" monitor can serve to establish the attainment status of the area. The required placement of monitors varies according to the individual NAAQS, but in general they are expected to measure area-wide conditions.

The CAA regulations also direct regulators to address "hot spots" for certain pollutants, in places where localized emissions may be expected, such as those that occur in the context of transportation projects. These air quality hot spots are partly the product of redlining (Nelson et al., 2018), a common real estate practice which began in the 1930s that produced a legacy in which communities of color are substantially more likely to live within or adjacent to the most heavily polluted airsheds. In some parts of the U.S., a significant proportion of black households live within 30 miles of a coal-powered power plant, while the proportion of people of color who live in "fence-line" communities is up to 75% greater than the general population in the US.

The recommendations in this section should be viewed as a platform for dialogue between EPA and its EJ stakeholders, not a comprehensive accounting of the complex, diverse and localized nature of air quality issues impacting communities of color.

Successes

Because the Clean Air Act establishes a national standard for clean air that applies uniformly, it has been characterized as "establish[ing] clean air as a right of all people of the United States."[137] Between 1970 and 2017, the aggregate national emissions of the six criteria pollutants were reduced by an average of 73 percent, and in the period from 1990 to 2017, concentrations of air pollutants improved "80% for lead, 77% for carbon monoxide, 88 percent for sulfur dioxide (1-hour), 56 percent for nitrogen dioxide (annual), and 22 percent for ozone." While these reductions are national averages, the substantial improvements in air quality have reduced health hazards in many EJ communities.

Mean ambient concentrations of lead (Pb) have continuously and measurably declined since the inception of the CAA, accelerated by EPA's phasing out of lead in gasoline, reducing risks to EJ communities. And while lead exposure in EJ communities commonly occurs through lead-based paint and pipes, industrial emissions of lead add another pathway of exposure, through inhalation of airborne

and depositional lead.[138] Reductions in lead emissions help reduce neurological damage to children and cardiovascular impacts on adults, particularly as there is a linear correlation between levels of lead in the air and in human blood.[139]

Mercury emissions declined by nearly 80 percent between 1990 and 2014, due in large part to EPA's regulation of major mercury sources, including municipal waste combustion and medical waste incineration. Mercury deposition from atmospheric emissions is a well-established route to contamination of fish and shellfish, where toxic methylmercury bioaccumulates.[140] This illustrates how the NAAQS primary standards protect public health directly, but are accelerated when the NAAQS secondary standards, through protection of ecosystems, also result in public health benefits. In the case of mercury, contaminated fish and shellfish impact American Indian/Alaska Native populations, certain Asian populations, and some black communities in the Southeast, who can have high dietary exposure to mercury if they among those with higher fish and shellfish consumption rate than the general population. (USEPA uses a mean per capita ingestion rate of 20.1 grams/day for the general population, and with tribal populations, recommends the use of the 99th percentile, or 215.7 grams per day.[141] Through the CAA, reductions achieved in atmospheric emissions since 1990 are associated with reductions in fish methylmercury concentrations. This measurable reduction was noted by CDC, who observed a 34% decline in blood mercury concentrations in women of childbearing age, from 1999-2010.[142]

Sulfur Dioxide has dropped in part due to the use of marketable pollution allowances, which in turn cut power plant emissions that contributed to acid rain. Reducing acid rain has minimized the damage to water quality in lakes and streams, and the subsequent harms to fish and wildlife. According to EPA's *Progress Cleaning the Air and Improving People's Health* webpage, between the 1989 - 1991 and 2009 - 2011 observation periods, wet deposition of sulfate (which causes acidification) decreased by more than 55 percent on average across the eastern United States.[143]

American/Indian, Alaska Natives and African Americans have the highest rates of asthma prevalence in the United States. Pollutant reductions accomplished through the CAA directly aid in reducing these asthma disparities. Due to the CAA, ***stationary sources, often within EJ communities, emit about 1.5 million tons fewer air toxics than was the case in 1990*** (US EPA Air Toxics Program). An additional 1.5 million tons per year of hazardous air pollutants (HAPs) were reduced from mobile sources (US EPA, 2014). This reduction is an important success, as many EJ communities live closer to public transit and major roadways, and traffic-related air pollution is positively associated with asthma.[144]

Pioneering research and developing of modelling tools has provided new methods for assessing cumulative risks to vulnerable communities. The development of EJSCREEN, EPA's EJ mapping and screening tool, is a notable success. EJSCREEN consists of 11 environmental indicators and six demographic indicators, reported at the census block level. This integration of data layers enables air quality agencies to assess cumulative and/or disproportionate impacts during their permitting process and guide decisions on monitor placement.

Improvements in air emissions inventories and modeling techniques have enabled EPA to examine a wider range of air toxics and to calculate potential lifetime cancer risks associated with the pollutants. One example is EPA's National Air Toxics Assessment (NATA), which has provided multiple indicators that

are used in EJSCREEN. While NATA can help EJ communities explore air toxics risks, there are limitations, including that NATA is best applied broadly, at the county, state, or national level to determine absolute risk levels, but it can also be used to identify relative risks by Tract within counties.

The citizen suit and judicial review provisions of the CAA provide legal mechanisms for addressing issues in EJ communities. Two sections of the CAA authorize citizen participation in CAA enforcement and the implementation of CAA provisions. Section 304 of the CAA allows for citizen suits against CAA violators or against the EPA where there is a failure to perform any act or duty. This provision has been successfully used to address compliance issues in EJ communities. Section 307, meanwhile, allows for judicial review of EPA regulations and final actions taken under the authority of the CAA. These provisions are particularly meaningful when EJ communities have access to compliance information. EPA has established several online tools that provide key air quality data, including the "Enforcement and Compliance History Online (ECHO), which enables users to search facilities in their community, and assess their compliance with environmental regulations. Similarly, EPA's Toxic Release Inventory (TRI) program enables EJ communities to track chemical releases in their neighborhoods.

President George H.W. Bush established the Office of Environmental Justice in 1992 through an Executive Order. The Office of EJ works collaboratively with EJ communities, providing direct support (financial resources, technical assistance) as well as partnerships, such as the National Environmental Justice Advisory Council (NEJAC). The NEJAC, along with staff in the EJ office, are part of the effort to build additional capacity among EJ communities, which contributes to racial equity through improvements in implementation and enforcement of the CAA.

Future Challenges and Opportunities

1. EPA has the opportunity to address EJ hotspots and concerns through enhanced monitoring and modeling, using technologies and methods that improve characterization of exposure. New data techniques, such as dispersion modeling, enable researchers to understand emission sources and exposure patterns at finer spatial resolutions. This type of data will help inform both CAA regulatory and non-regulatory actions, as well as provide a stronger scientific basis for agency planning and decision-making. Higher-resolution photochemical modeling for O_3 and $PM_{2.5}$ would also be helpful. For example, EPA often provides 12 km x 12 km modeling nationwide, but within communities, 4 km x 4 km or 1 km x 1 km modeling would really be needed to assess disproportionate impacts on EJ communities/neighborhoods.

2. The application and rapid expansion of alternative monitoring technologies, such as low-cost sensors, provides EPA with an additional opportunity to understand local air quality conditions. Though sensor performance and accuracy are still evolving, and issues must be resolved with respect to some programs, such as the NAAQS, sensor data will increasingly enable EPA to assess exposure patterns at a far more localized scale. Sensor data, strategically collected in EJ hotspots, can help evaluate changes in exposure to criteria and other air pollutants. Sensor data may also help the agency with future federal reference methods (FRM) monitor siting, and can also be used for non-regulatory purposes, as example, for public health risk communication.

3. High quality data, such as that collected from FRM and federal equivalent methods (FEM) monitors, will become even more critical for issuing accurate and timely public health advisories. EJ communities may experience heightened risk during air quality events due to a combination of land-

use patterns, socio-economics, underlying health conditions and demographics. Exposures can be mitigated at least partially through effective risk communication about air quality conditions. Monitoring data of poor inherent quality can lead to inaccurate or delayed information to public health authorities and in turn, to the public.

4. The NAAQS are effective in protecting public health, by establishing maximum allowable pollutant levels for individual pollutants. However, the statutory pollutant-by-pollutant approach of some CAA programs does not always adequately address the situations in which a community may be exposed to elevated levels of multiple pollutants.

Recommendations

1. **Incorporate EJ more extensively and transparently into key risk assessment analyses**. Broadly, EPA should be incorporating EJ considerations into the design and reporting of all of its key air quality risk assessments, based on our knowledge that failing to do results in mischaracterization of risk of both EJ communities and non-EJ communities. Specifically:

    1.1. **EPA should strengthen its understanding of multi-pollutant exposures**. Only by applying a multi-pollutant approach to understanding and reducing risks from air pollution a single-pollutant approach to air quality management. The agency can draw from its collaboration with exposure scientists and epidemiologists to improve characterization of health risks where multiple emission sources have been documented, focusing on vulnerable populations. This information can be used by the agency to identify variations in EJ community exposures and leverage multipollutant authorities under the Clean Air Act.

    1.2. **EPA should make it a priority to improve emissions inventories for sources that would significantly impact EJ risk characterization**. When EPA conducts reviews of emissions inventories for completeness, accuracy, and representativeness, it should include a special sub-analysis for EJ communities and ensure that adequate attention and resources are allocated to improving inventories that would be most likely to influence risk characterization in EJ communities.

    1.3. **Incorporate EJ-specific risk assessment and analysis into the NATA.** Data from the National Air Toxics Assessment (NATA) is integral to risk assessments in EJ communities and to conducting multi-pollutant exposure assessments. In addition to the overall recommendations related to the NATA the “Air Toxics” section of this report, the CAAAC also recommends that EPA incorporate EJ screen into the report and include special analysis and summaries of risk for EJ communities. For example, the term “Environmental Justice” doesn’t appear in either the results summary or the technical support document for the 2014 NATA, making it harder to understand the special burdens EJ communities may face in exposure to Air Toxics.

    1.4. **Continue to incorporate EJ considerations into NAAQS reviews**. When conducting NAAQS reviews, EPA should ensure that it includes analyses on the extent to which exposures vary by race, ethnicity, and income, and should include more neighborhood-scale analyses in order to ensure consideration of these factors in setting appropriate NAAQS. A good example of where race/ethnicity and income-level analysis were explicitly incorporated into a NAAQS review as the 2020 PM NAAQS review, which did show differential exposures by race and income.

1.5. **EPA should support methods for mapping community vulnerability to climate-related air quality events**. Disproportionate impacts of climate change based on race and class are outlined in the scientific literature on climate change, but EPA can inform agency policy by accelerating the use of this data through its spatial screening tools, and is uniquely suited to carry out or guide these types of analyses in the future. EPA can and should also account for how phenomena like the urban heat island effect and heat waves can exacerbate the effects of exposure to air pollution for EJ communities.

1.6. **EPA should use EJSCREEN and other analytical tools to incorporate EJ considerations into other agency air quality analyses to the extent possible**. The agency should use data and data integration tools, such as NATA and EJSCREEN, to strategically identify areas for additional monitoring, analysis, and outreach. EJSCREEN data should also be used to help inform how the EPA develops CAA regulations, programs, and activities, and imposes other requirements, such as State Implementation Plans. Strengthening modelling technologies and mapping tools will further the agencies' capacity to support EJ communities, in what Dr. Charles Lee, principal author of the landmark report Toxic Wastes and Race in the United States, describes as a decades long journey "from describing to quantifying to mapping disproportionate impacts."

2. **Expand and Enhance Air Pollution Monitoring in EJ Communities**. Despite decades of meaningful investment in a national monitoring network, there are still gaps in EPA's monitoring data in EJ communities. Meeting current requirements for state/local/tribal monitoring networks does are not necessarily providing adequate information on how pollution levels vary between EJ and non-EJ communities. Network expansion is also necessary to provide data for exposure modeling, for analysis of cumulative effects and to characterize impacts among people living in close proximity to stationary sources. For example, in 2008, the Minnesota Pollution Control Agency (MPCA) adopted the Minnesota Cumulative Air Permitting Protocol, establishing a requirement to analyze and consider "*cumulative levels and effects of past and current environmental pollution from all sources on the environment and residents of the geographic area within which the facility's emissions are likely to be deposited.*" (MPCA, 2008).

2.1. **EPA should conduct an analysis of the current regulatory monitoring network to adequately characterize air pollution exposure in EJ communities**. While low-cost sensors are a great way to enhance the general understanding of air pollution in an area, they are not a substitute for regulatory monitors, and the lack of regulatory monitors in an EJ community could lead to any non-regulatory data collected within these communities to be not taken as seriously as the situation might warrant. In light of this, EPA should conduct a nationwide review of the adequacy of the current network to characterize the number and type of monitoring stations placed directly within EJ communities and known hot-spots, and periodically update this analysis once every five years.

2.2. **EPA should explicitly account for EJ considerations in approval of monitoring network plans and reviews**. EPA has the authority to set standards for the approval of state/local/tribal monitoring network plans and should consider using this authority to ensure that adequate resources are being allocated to monitor air pollution in EJ communities. For example, EPA could consider 40 CFR §58.10 as a potential area for revisions to address these issues.

3. **EPA should work to expand the capacity of EJ organizations**. It is important to ensure that the communities themselves have the ability to work on air quality issues and remain engaged in their communities. This will help ensure more durable engagement from EJ communities in all aspects in the implementation of the Clean Air Act.

    3.1. **EPA should increase Clean Air Act funding for community-based programs through grants and cooperative agreements**. This will help build capacity to engage as stakeholders in air quality regulation, monitoring and policy, as well as to advise on air quality matters that they have prioritized.

Additional References

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Greenhouse Gas Emissions and Climate Change

Overview

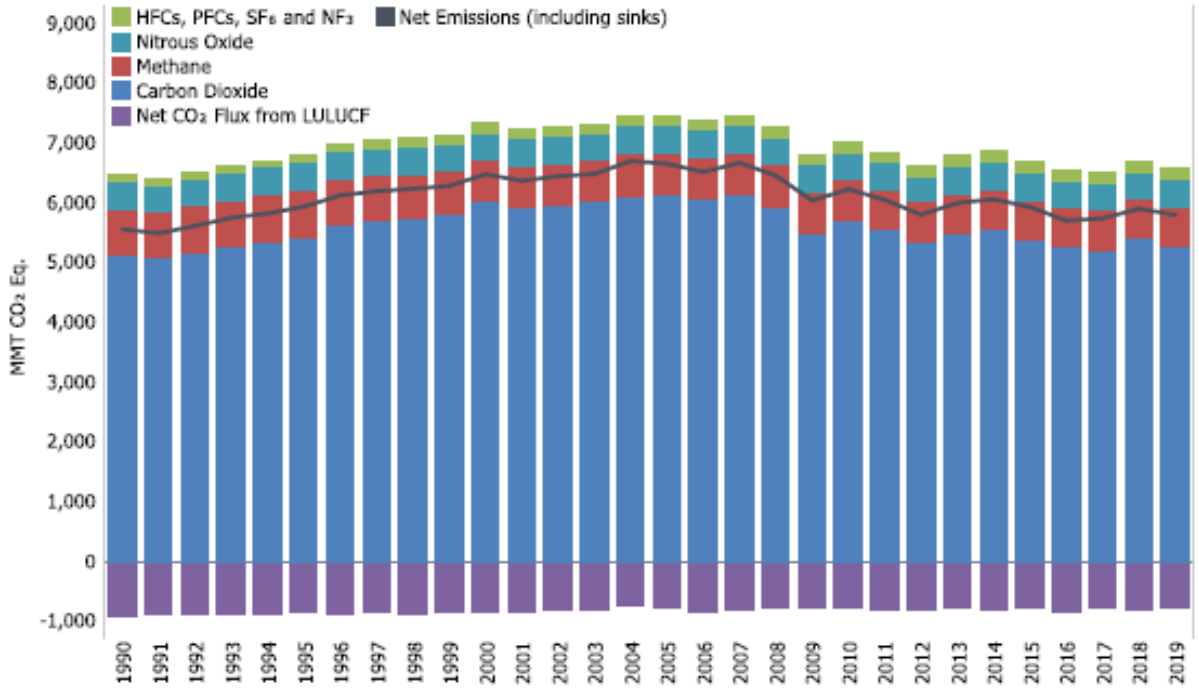
As might be expected, views among CAAAC members concerning past utilization of the CAA to address greenhouse gas ("GHG") emissions and climate change -- and what actions may be available and/or necessary in the future – differed in substance, form, and direction. Some members view climate change as an existential challenge requiring EPA to use the CAA to focus on major emitters across all stationary and mobile sectors. Other views, not necessarily in conflict, focused on securing broad international action on climate change relying on provisions of the Act not previously utilized to control GHGs. Some members emphasized the role of states and localities to address climate issues and urged broader cooperation with EPA. Other opinions centered on the need for clear accounting rules and reliable data to both allow for proper assessment of emissions and to allow for determination of the GHG impact of domestic and international products. Still other opinions recommended that EPA use the CAA to approach GHGs as a "co-pollutant" largely occurring as a by-product of combustion.

While this report focuses on the 50-year history of the "modern" Clean Air Act and the remaining challenges and opportunities that lie ahead, it must first be observed that efforts to utilize the Act to address GHGs are still very much a work in progress. Within the full history of the CAA, using the legal authority of the Act to directly control GHGs is of relatively recent vintage, with most activity occurring following the 2007 seminal Supreme Court decision in *Massachusetts v. EPA*. And, as outlined below, these efforts have been met with varying levels of success and, in some cases, have engendered years of litigation.

The most recent estimate of U.S. GHG emissions showed that total gross emissions in 2019 were approximately 2% above 1990 levels.[145] Domestic GHG emissions declined 1.7% in 2019 and could also be expected to be significantly lower in 2020 due to the broad impacts of COVID on economic activity.[146] But, when viewed over a longer timeframe, the two-decade trend of U.S. GHG emissions is fairly stable, meaning that while overall carbon intensity and more efficient production/use of GHGs has steadily improved, these actions have not been sufficient to substantially offset additional transportation, electric generating, industrial and other source emissions.

This is not to discount the progress that has been made, particularly in recent years. Between 2018 and 2019, total reported GHGs from large facilities in the U.S. declined by 5% and powerplant GHG emissions by 25% between 2011 and 2019.[147] But GHG emissions in 2021 and 2022 may reasonably be predicted to increase as travel, energy demand and industrial production recover from the global economic disruption experienced for much of 2020. Thus, whether the downward trend in total GHG emissions over the last decade can be sustained or supplemented remains to be seen.

Figure 5. U.S. Greenhouse Gas Emissions by Gas



Opinions differ with respect to how the United States should address GHG emissions, in what timeframe and how aggressively. This report does not attempt to resolve all of the broader issues concerning GHGs and climate change, nor address the full range of governmental, private sector and personal actions that may be necessary to meet either domestic or international targets for reducing emissions and/or achieving longer-term goals. This report, however, does address a key part of United States climate change policy: implementation of the CAA. Absent more comprehensive legislative authority – such as economy-wide "cap and trade" measures, federal clean energy standards, taxation of carbon/GHG emissions, or additional state and regional regulatory efforts – the CAA remains a central, if not the most important, existing statutory tool to reduce GHG emissions in the United States.

The CAA assumes this importance given the breadth of potential authority to control air pollution from stationary and mobile sources and, directly or indirectly, consumer products. Certain regulatory actions may also affect the pricing and availability of higher GHG content/emissive products and services. And at least in some significant respects, CAA authority regarding GHGs may not be viewed by some as imposing sufficient requirements to address the issue adequately. Various provisions of the CAA require the Administrator of the EPA in his or her expert judgment to consider and weigh specific statutory factors in promulgating new standards. In addition, certain provisions of the Act treat new facilities and new products differently than existing facilities and products. And CAA regulations are also focused on various regulated entities as defined by the Act, not the utilization of energy or the emission of GHGs in the U.S. economy as a whole.

In addition, with respect to certain authorities, the ability to implement emission reductions is premised on federal, state, and local co-operative efforts. As reflected in the Permits section of this report, many CAA source-level controls are determined through case-by-case determinations, largely implemented at the state level, or by the use of other authority wherein states are charged with determining the specific

level of control.[148] Rather than a uniform "one size fits all" regulatory construction, in multiple respects the CAA requires that emission reductions be tailored to account for local circumstances.

But absent additional congressional action to address climate change, the CAA must still be viewed as the existing measure that Congress has directed to be utilized to control the major sources of GHGs in this country.[149] When the "modern" CAA was passed in 1970, GHG emissions were not specifically identified as a focal point, albeit "climate" and "weather" were included within the definition of adverse welfare effect. The major rewrite of the CAA that occurred in 1990 also did not focus on climate. The 1990 Clean Air Act Amendments primarily addressed requirements for the more traditional (criteria) pollutants and provisions to assure their attainment, new authority for EPA to address air toxics, a new title to address acid rain, requirements for operating permits and authority to implement the Montreal Protocol and phase out ozone depleting substances.[150] In the three decades since the last comprehensive amendments to the CAA, however, the impact of GHG emissions has become better understood. Congress also sought to develop additional information on GHG emissions by directing EPA to promulgate a GHG monitoring rule utilizing existing authority contained in the CAA and providing appropriate funds for this effort.[151]

And, as outlined below, the CAA has been successfully used for the last decade to control GHG emissions from nearly all on-road mobile sources (and, subject to ongoing litigation) fossil fuel-fired powerplants, the two major sources of GHGs in the United States. Additional actions have been taken under the CAA to address high global warming potential substances, including refrigerants used in mobile and stationary applications. And EPA has implemented specific authority contained in the CAA concerning the renewable content of transportation fuel. These initiatives have not been taken without at least some degree of controversy and in many cases, lengthy litigation.

Successes

Section 812 of the Clean Air Act Amendments of 1990[152] required EPA to address the effect of the Act on the "public health, economy and environment of the United States" and to issue a report to Congress considering certain factors. In 1997, EPA published a retrospective analysis of the Clean Air Act address the benefits and costs of the Act from 1970 to 1990. This study estimated total monetized benefits from 1970 to 1990 in the range of $5.6 to $49.4 trillion, with a central estimate of $22.2 trillion. Estimated compliance costs were $0.5 trillion.[153] A large percentage of benefits were attributed to avoid mortalities from particulate matter and lead emissions.[154] EPA subsequently updated this analysis to cover the period 1990 to 2020.[155] While this report necessarily incorporated certain assumptions concerning future implementation of the Clean Air Act, substantial net benefits were also forecast.[156]

A comprehensive analysis of costs and benefits of regulating GHG emissions under the CAA -- at least to the knowledge of CAAAC -- does not exist.[157] Thus, any itemization of the "successes" of the CAA with regard to GHG emissions will necessarily include several qualitative as well as quantitative judgments.[158] GHG reductions, in terms of gross and net emissions, can and have been quantified with respect to individual rulemakings. But, in some cases, resulting benefits may not solely be attributable to CAA emission standards, such as with the sizeable migration of electric power generation from coal-fired to natural-gas and wind generation over the last six years.[159] And in other cases, the extent of net economic benefits have been dependent on several factors, including the relative "discount" rate to apply to GHG reductions.[160]

This report is not designed to address the larger debate over the desirable past or future extent of GHG emission reductions or to the extent such actions are necessary or cost-effective. From many perspectives, GHG emissions and climate change represent an existential threat. The most recent synthesis report of the Intergovernmental Panel on Climate Change confirmed that "human influence on the climate system is clear and growing, with impacts observed across all continents and oceans . . . stabilizing temperature increase to below 2°C relative to pre-industrial levels will require and urgent and fundamental departure from business as usual."[161] The Fourth National Climate Assessment indicated that "[c]limate change creates new risks and exacerbates existing vulnerabilities in communities across the United States, presenting growing challenges to human health and safety, quality of life, and the rate of economic growth."[162] The report also emphasized that "[w]ithout substantial and sustained global mitigation and regional adaption efforts, climate change is expected to cause growing losses to American infrastructure and property and impede the rate of economic growth over this century."[163]

Rather, the report first focuses on the history of regulating GHGs under the authority of the Clean Air Act and rules that have been promulgated to date. The opportunities for future reductions are thereafter analyzed, along with the future challenges of utilizing the Clean Air Act to enable such reductions.

1. Clean Air Act Actions Addressing Greenhouse Gas Emissions (1990-present)

Following enactment of the 1990 Clean Air Act Amendments, EPA required that certain sources monitor CO_2 emissions in accordance with section 821 of the amendments.[164] EPA also published the global warming potential of class I and class I substances in accordance with CAA §602(e) and considered such in taking certain actions to approve new substitutes under CAA §612. But because the CAA did not explicitly call for the direct regulation of GHGs under any specific provision of the Act, questions arose with respect to EPA's legal authority to regulate GHGs and, if legal authority existed, whether the Agency was required by any provision to regulate GHGs. These issues sparked differing opinions as to how the CAA could be interpreted.

In 1998, EPA General Counsel Johnathan Z. Cannon drafted a memorandum concerning "EPA's Authority to Regulate Pollutants Emitted by Electric Power Generation Sources." This memorandum, drafted in response to a congressional hearing, discussed the CAA's definition of an "air pollutant" and concluded that specific provisions of the CAA could allow for regulation of CO_2 if the EPA Administrator "determined under one or more of those provisions that CO2 emissions are reasonably anticipated to cause or contribute to adverse effects on public health, welfare, or the environment."[165] The memorandum also indicated that the ability to take certain actions, which might include a "cap-and-trade program depended on the actions or the inactions of the states."[166]

In 2003, EPA General Counsel Robert E. Fabricant expressed a different view of EPA's authority on the basis of a petition filed with the Agency by the International Center for Technology Assessment.[167] This memorandum expressed the view that the "CAA does not authorize EPA to regulate for global climate change purposes. This opinion was based on the existence of several limited provisions in the CAA that address CO_2 and that the Act was not "specifically tailored" for certain global atmospheric issues, not including climate change. In 2007, fundamental issues concerning EPA's authority to address GHGs under the CAA were "settled" by the Supreme Court. In *Massachusetts v. EPA*, 127 S.Ct. 1438 (2007), the court held, in part that GHGs unambiguously fit into the Clean Air Act's "sweeping definition" of an "air pollutant." *Id.* at 1460, citing 42 U.S.C. §7602(g). The court also determined that EPA had statutory

authority to regulate emissions of GHGs from motor vehicles and, further, that any decision by EPA to determine whether GHGs endanger public health or welfare must be grounded in the statute. *Id.* at 1463.

While EPA had previously encouraged reductions in GHGs through voluntary programs (such as the EnergyStar program for labeling energy efficient products or the Smartway program for encouraging the use of lower-emission trucks and transport vehicles) *Massachusetts v. EPA* effectively shifted the debate over use of the CAA to address GHGs. Indeed, while multiple EPA public/private partnership programs still exist,[168] EPA responded to the decision with a series of actions that have continued until the present, with the most recent CAA GHG rule published in the Federal Register in January 2021.

In general chronological order, EPA has taken the following actions:

- *2008 Advance Notice of Proposed Rulemaking*, 73 Fed. Reg. 44,354 (July 30, 2008). This lengthy notice was the result of internal analysis by EPA regarding potential parts of the CAA that could be utilized to control GHGs. The 2008 ANPRM surveyed both available statutory authority, possible approaches to the use of that authority and possible limitations. Specifically, EPA reviewed the potential to use the following authorities to determine if they could be applied to GHGs:
    - New Source Performance Standards for new, modified, and existing stationary sources, including the potential available of "flexible" approaches to regulation.
    - Related requirements to address necessary "endangerment" and "cause and contribute" determinations with regard to CAA §111.
    - Title II mobile source provisions, including provisions for on-road engines and vehicles, non-road vehicles and engines (including ocean-going vessels, locomotives, construction equipment, farm tractors, forklifts, harbor crafts and lawn and garden equipment), aircraft engine standards, fuels, and fuel additives.
    - National Ambient Air Quality Standards, through listing GHGs pursuant to CAA §108 and promulgating standards pursuant to CAA §109 and related provisions for the designation of areas under CAA §107 and requirements related to state and federal implementation plans (CAA §§110, 179).
    - CAA §112 requiring listing of hazardous air pollutants, maximum achievable technology standards and resulting residual risk and technology reviews.
    - CAA §115 related to state implementation plan obligations to address international transport of air pollutants.
    - CAA §129 solid waste combustion standards.
    - Implications of regulating GHGs under the CAA with regard to prevention of significant deterioration and nonattainment new source review permitting as well as title V operating permit provisions, including the potential use of cap-and-trade and market mechanisms.
    - CAA title VI addressing ozone depleting substances, including the CAA §612 program for significant new alternatives and utilization of CAA §615, which requires a separate endangerment finding related to the stratospheric ozone layer.

- *2009 Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act*, 74 Fed. Reg. 66,496 (Dec. 15, 2009). The EPA Administrator found that six GHGs (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) endanger both the public health and public welfare. In addition, the EPA Administrator determined that the combination of these six GHGs from new motor vehicles contribute to the GHG air pollution that endangers public health and welfare pursuant to CAA §202(a).

- *2010 Light Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards,* 75 Fed. Reg. 25,324 (May 7, 2010). The rule promulgated both GHG emission standards for carbon dioxide, methane, nitrous oxides, and hydrofluorocarbons for 2011-2016 light duty vehicles for 2011-2016 and comparable fuel economy (CAFE) standards promulgated by the Department of Transportation under its Energy Policy and Conservation Act authority.

- *Greenhouse Gas Emission Standards and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles*, 76 Fed. Reg. 57,106 (Sept. 15, 2011). EPA promulgated carbon dioxide standards (CO_2/ton-mile) for medium- and heavy-duty vehicles for MY 2014-2018 vehicles in weight classes 2b to 8 (*e.g.*, delivery trucks, vocational vehicles, transit and school buses through long-haul tractor/trailer trucks). Utilizing new authority conveyed in the 2007 Energy Independence and Security Act, DOT promulgated comparable fuel consumption standards (gal/1,000 ton-mile). Additional credits were available for innovative and "off-cycle" emission reductions not measurable through traditional emissions testing.

- *2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emission and Corporate Average Fuel Economy Standards*, 77 Fed. Reg. 62,624 (Oct. 15, 2012). This rule extended GHG standards for light duty vehicles to the 2025 model year, subject to a Mid-Term Evaluation of MY 2022-2025 standards; comparable CAFE standards through MY 2021 due to limitations in its authority; "augural" standards applied for later MYs.

- Standards of Performance for Greenhouse Gas Emissions from New, Modified, and Reconstructed Stationary Sources: Electric Generating Units, 80 Fed. Reg. 64,510 (Oct. 23, 2015). Established CO_2 standards for newly constructed, modified and reconstructed fossil fuel-fired electric utility generating units ("EGUs"), both utility steam (1,400 lb CO_2/MWh-g for new units and 1,800 or 2,000 lb CO_2/MWh-g for modified sources) and stationary combustion turbines (1,000 or 1.030 lb CO_2/MWh-g for baseload units).

- Protection of Stratospheric Ozone: Listing of Substitutes for Refrigeration and Air Conditioning and Revision of the Venting Prohibition for Certain Refrigerant Substitutes, 80 Fed. Reg. 19,454 (Apr. 20, 2015); Protection of Stratospheric Ozone: Change of Listing Status for Certain Substitutes Under the Significant New Alternatives Policy Program, 80 Fed. Reg. 42,870 (Jul. 20, 2015). These two rules utilized the Significant New Alternatives Policy program to require that certain end uses of certain high global warming substances be phased out on the basis of the existence of safer substitutes. Both rules, however, were later partially vacated and remanded to the EPA. Mexichem-Fluor, Inc. v. EPA, 866 F.3d 451, Mexichem-Fluor v. EPA, No. 17-1024 (D.C. Cir.).

- *Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources, 81 Fed. Reg. 35,824* (June 3, 2016). This rule set standards for both GHGs and volatile organic compounds ("VOCs"), including hydraulically fractured gas well completions and equipment leaks at

natural gas processing plants, pneumatic controllers, centrifugal compressors, and reciprocating compressors. A subsequent rule rescinded methane standards and altered VOC standards; this rule is currently in litigation and the rules are stayed pending further EPA review.

- Finding that Greenhouse Gas Emissions from Aircraft Cause or Contribute to Air Pollution That May Reasonably Be Anticipated to Endanger Public Health and Welfare; Final Rule, 81 Fed. Reg. 54,442 (Aug. 15, 2016). This finding applied to the same six GHGs as addressed in the CAA 202(a) endangerment determination and found that emissions of these GHGs from certain aircraft are contributing to air pollution that endangers public health and welfare pursuant to CAA §231(a)(2)(A).
- *Standards of Performance for Municipal Solid Waste Landfills*; Final Rule, 81 Fed. Reg. 59,332 (Aug. 29, 2016). The rule lowered emission thresholds at which a landfill must install controls for reducing emissions (methane).
- *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles – Phase 2*, 81 Fed. Reg. 73,748 (Oct. 25, 2016). The Phase 2 rule extended and expanded GHG emission standards for medium and heavy-duty trucks through MY 2027. Consistent with the previous rule, EPA defined separate engine standards, but also included regulations affecting vehicle trailers and included additional modeling inputs to define vehicle standards. NHTSA promulgated "maximum feasible" standards utilizing gal/1000 ton-mile metric.
- *Control of Air Pollution from Airplanes and Airplane Engines: GHG Emission Standards and Test Procedures*, 86 Fed. Reg. 2,136 (Jan. 11, 2021). The EPA adopted standards that are applicable to certain classes of subsonic aircraft applying a standard for carbon dioxide emissions equivalent to that adopted by the International Civil Aviation Organization. The standard applies on the basis of a "whole airplane design" that accounts for aerodynamics, airplane weight and engine propulsion technologies. EPA regulations specify a fuel efficiency metric value that utilizes the specific air range of an aircraft and a reference geometric factor related to the size of an aircraft's fuselage.
- *Renewable Fuel Standards (2006-present)*. Apart from regulations dependent upon EPA's endangerment and cause and contribute determinations, EPA has promulgated a series of rules that provide for annual renewable fuel standards. Beginning with the enactment of the Energy Policy Act of 2005, EPA was directed to promulgate rules specifying a quantity of renewable fuel to be blended into transportation fuel (primarily gasoline and diesel). Congress expanded the RFS program in 2007 (Energy Independence and Security Act of 2007). Through 2020, EPA promulgated approximately a dozen rules and determinations that specifying annual standards for compliance years 2006-2020.
- *New Source Performance Standards for Fossil Fuel-Fired Generation* (2012-present). The long history of EPA's rulemaking efforts in this area, along with related litigation and litigation outcomes, is beyond the scope of this report. EPA has proposed and finalized different approaches to define standards of performance for the existing fossil fuel fired electric generating units, most notably with regard to the Clean Power Plan[169] and the Affordable Clean Energy Rule.[170] Pursuant to litigation, neither of these rules are currently in effect.[171] Currently, CAA section 111 GHG standards only apply to new, modified and reconstructed sources.[172] Despite this lack of final regulation, however, GHG emissions from power plants peaked in 2007 are now at the lowest level since the late 1970's.[173] While many factors contribute to this decrease, including a decrease in coal generation and corresponding

increase in gas-fired generation, it is certainly noteworthy EPA's regulations (even if targeted at other pollutants) have contributed to this decrease.

- *GHG Reporting Rules*. Since 2009, EPA has issued a series of reporting rules for greenhouse gases from various source categories.[174] These rules require annual reporting above specified thresholds for sectors of the U.S. economy under actions taken pursuant to annual appropriations legislation.[175] EPA was directed under these enactments to use its existing authority under the CAA to require reporting and has exercised authority contained in CAA sections 114 and 208.

Opportunities

While we would note the progress outlined above with respect to regulating major industry segments that contributes to climate change, it is clear that multiple opportunities remain. Some of the challenges/opportunities are technical and analytical in nature, such as defining what alternatives exist to current industry practices and products. But significant legal and policy issues also remain with respect to the utilization of the CAA to control GHG emissions. With respect to these issues, any single analysis of CAA legal authority could easily demand a lengthy discussion, including a range of informed opinion. This section endeavors to discuss each area briefly, but with enough context in order to identify the main issues and perspectives.

In general, opportunities obviously exist within the scope of GHG sources that may be subject to control under the CAA.

Figure 6. Total U.S. Greenhouse Gas Emissions by Economic Sector in 2019

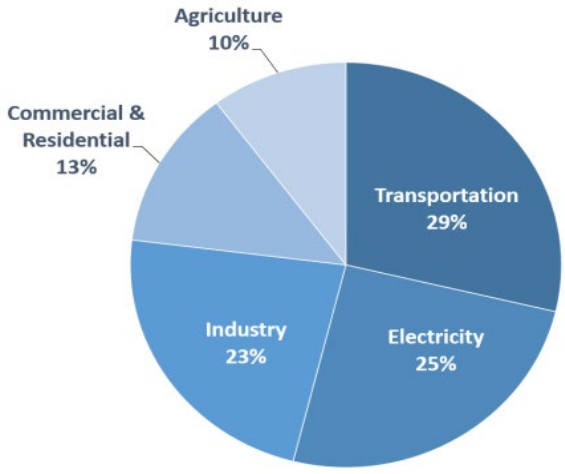
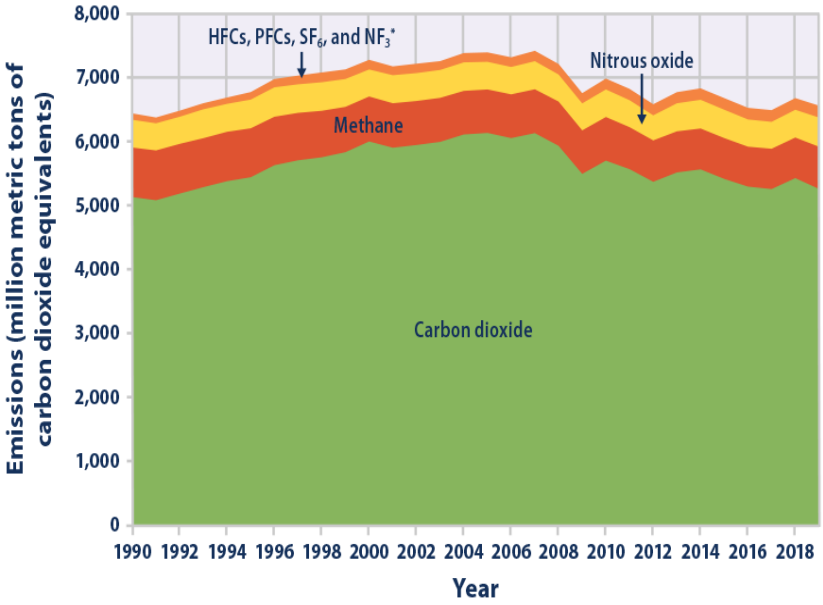


Figure 7. U.S. Greenhouse Gas Emissions by Gas, 1990-2019



* HFCs are hydrofluorocarbons, PFCs are perfluorocarbons, SF_6 is sulfur hexafluoride, and NF_3 is nitrogen trifluoride.

Data source: U.S. EPA (U.S. Environmental Protection Agency). 2021. Inventory of U.S. greenhouse gas emissions and sinks: 1990–2019. EPA 430-R-21-005. www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

EPA rulemaking to date has involved two large sectors of GHGs: fossil fuel-fired EGUs and transportation. EPA is also currently engaged in rulemaking to address HFC emissions, albeit such actions are being taken under statutory authority outside of the Clean Air Act.[176] In addition, major sources seeking preconstruction permits may also be required to assess and potentially control GHGs. Therefore, EPA may continue to utilize its CAA authority and engage in additional rulemaking for these segments of the economy and potentially other segments, *e.g.,* additional sources subject to CAA section 111 performance standards. In addition, the Paris Climate Accord provides a framework for countries to develop a Nationally Determined Contribution and to report of actions taken to address GHG reduction goals. But, as outlined below, broader action will need to involve additional assessment of EPA's authority under the CAA and additional rulemaking conforming to that authority.

Future Challenges

1. Extent and limits of CAA Authority

To date, EPA has utilized CAA §§111(a), 111(d), 202(a), 231 and 612 to promulgate standards or regulations directly affecting the emission of GHGs. As noted above, EPA has utilized its CAA authority to regulate fossil fuel-fired electric generating units, light, medium, and heavy-duty vehicles, aircraft, and hydrofluorocarbons contained in certain products or use in a specific application. EPA's implementation of the CAA over this period therefore can provide valuable "lessons learned" as well as insight into future challenges.

But while EPA has promulgated regulations – and in some cases multiple regulations – under these CAA authorities, the full extent of EPA's authority to regulate sources of GHGs under the CAA is currently unknown, as well as potential gaps in that authority. For example, with regard to mobile sources, EPA has either chosen or is restrained by the Act to promulgate standards in increments of several Model Years.[177] In addition, where exertion of CAA authority requires technical assessments and/or consideration of feasibility or costs, there may be practical limits to how expansive standards may be promulgated. Other issues occur with respect to the form that CAA standards may take, including the extent of compliance flexibility that may be allowed under various provisions. Opinions differ on these issues, but the extent of CAA authority to control GHGs is largely a matter of legal analysis and the caselaw that has been generated to date. No single regulatory provision of the CAA was enacted to control GHGs, such as title IV of the CAA enacted to address acid rain from the EGU sector.

At the same time, an increasing body of scientific evidence points toward multiple effects emanating from climate change, including extreme weather conditions. These effects, indeed, could complicate efforts to address climate change. But while EPA received multiple petitions to regulate GHGs under other provisions of the CAA, the Agency has not thoroughly analyzed the full potential extent of its CAA authority to regulate GHGs under the Act, at least in a public fashion, since the 2008 ANPRM. Nor has the Agency expressed a coherent view with regard to how different measures might be integrated to reduce GHGs, or the potential limits of authority.

In some respects, this is not surprising. During the rulemaking process, EPA rarely describes the limits of its authority, but rather analyzes whether it has sufficient authority to promulgate the rule in question. But this also means that it is not possible to know, with precision, whether the CAA is capable of reducing U.S. GHG emissions to zero or to some value above zero.[178]

Apart from the CAA provisions cited above, various analysis has been published regarding:

- Promulgation of National Ambient Air Quality Standards ("NAAQS") for GHGs pursuant to CAA §§108, 109;
- Utilization of CAA 112 to promulgate hazardous air pollutant standards for sources of GHGs;
- Use of CAA §115 to regulate GHGs on the basis pollution emitted in the United States endangering public health or welfare in foreign countries where reciprocity exists;
- Utilization of CAA §615 to regulate GHGs on the basis of their effect on the stratosphere, especially ozone in the stratosphere.

We will briefly discuss each provision in turn.

1.1. CAA §§108-110 (GHG NAAQS)

CAA §108 allows the EPA to publish a list of "each air pollutant" which may "reasonably be anticipated to endanger public health and welfare . . . [which] results from numerous diverse mobile or stationary sources . . . for which [the EPA Administrator] plans to issue air quality criteria." Presuming that this criteria could be met, EPA would need to propose primary and secondary standards for GHGs pursuant to CAA 109.[179] Final standards would be those "requisite to protect to protect the public health [and] public welfare."[180] Promulgation of GHG NAAQS would then trigger obligations on the part of states to submit

State Implementation Plans that demonstrate how each state will attain and maintain the GHG NAAQS and include enforceable emission limits and other control measures.[181]

Multiple questions have been raised with regard to whether a GHG NAAQS either comports with CAA NAAQS provisions (including implementation provisions) and/or is feasible to implement for globally-mixed pollutants rather than air pollution that primarily affects local air quality.[182] EPA has adopted different views on this issue, rejecting a petition to establish a GHG NAAQS and then reversing its position.[183] Some have argued that a greenhouse NAAQS is possible, since EPA may develop a design value that is not simply based on the level of GHGs in the atmosphere, but rather with respect to limiting temperature increases and to establish benchmarks.[184] This, arguably would allow EPA to extend compliance deadlines past the maximum 10 years allowed under the CAA for attainment of a primary NAAQS by relying instead on implementation provisions requiring reasonable further progress.[185] Alternatively, it has been suggested that EPA could simply set a secondary GHG NAAQS under which no statutory deadline for a GHG NAAQS would apply.[186]

Others have maintained that a GHG NAAQS are inherently ill-suited for GHGs given the inability of states to control sufficient sources to reach attainment or the ability of EPA to promulgate a realistically achievable standard given that EPA is prohibited from considering the cost of implementing the standards when setting a NAAQS.[187] In other words, EPA could be faced with a Hobson's choice: if the Agency set a GHG NAAQS so as to be attainable, the Agency would not suitably address the statutory criteria for setting a NAAQS, or if EPA set a NAAQS at a "protective" level, the entire country would remain out of attainment for decades and states would have no means to attain the standard. EPA has long recognized these difficulties.[188]

1.2. CAA §112 Hazardous Air Pollutants (GHG MACT)

CAA §112(a)(6) provides EPA with authority to revise the statutory list of hazardous air pollutants to add "pollutants which present, or may present, through inhalation or other routes of exposure, a threat of adverse health effects . . . or adverse environmental effects . . ." Presuming a showing of adverse effects could be made, EPA would be required to set standards "for each category or subcategory of major sources and area sources of hazardous air pollutants" based on "the maximum degree of reduction in emissions . . . taking into consideration the cost of achieve such emission reductions [and other factors the Administrator] determines is achievable for new or existing sources . . . through he application of measures, processes, methods, systems or techniques . . . ." In shorthand, these standards are referred to as maximum achievable control technology ("MACT") standards and, for existing sources, are developed based on the "best performing" 12 percent of sources. For new sources, MACT standards are based on the best controlled similar source. MACT standards are subject to subsequent risk and technology review. *Id.* §112(d)(6), (f).

Some opinion has favored the CAA §112 approach given it focus on available technologies and other available methods to control GHGs. This focus, along with subsequent risk and technology review of CAA 112 standards would allow for EPA to consider feasible levels of control for a wide range of sources "in a new, comprehensive and significant manner."[189] Other opinion has considered CAA 112 standards to be a "poor fit" for regulating GHGs given: (1) definition of "major sources" as those emitting 10 tons per year ("tpy") of one hazardous air pollutant ("HAP") or 25 tpy of a combination of HAPs, meaning that numerous relatively small sources would need to be controlled and the need to impose "maximum" reductions.[190] In addition, the allowable timeframes for regulation sources under CAA 112 are relatively

short in terms of the longer timeframes generally considered necessary. EPA's 2008 ANPRM also noted that a relatively large number of source categories and subcategories (over 170) would need to be addressed.[191]

*1.3. CAA §*115 *International Air Pollution*

A significant amount of attention has been devoted to the consideration of whether CAA §115 could provide authority for EPA to regulate GHGs in an "economy-wide" program, potentially in conjunction with the Paris Agreement or other international measures to address climate change. CAA §115 actually predates the 1970 Clean Air Act and has been amended since its original enactment, but in its current form, "[w]henever the Administrator [based on information] has reason to believe that any air pollutant or pollutants emitted in the United States cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare in a foreign country . . . the Administrator shall give formal notification thereof to the Governor of the State in which such emissions originate." This notice, in turn, "shall be deemed" to be a finding under CAA section 110 requiring a state to revise its applicable state implementation plan. CAA §115 contains a "caveat" however, that the section is only to apply to a foreign country that has "given the United States essentially the same rights with respect to the prevention or control of air pollution occurring in that country as is given that country by [section 115]." This last provision is typically referred to as the reciprocity provision.

It has been argued that the legislative history of this provision supports its use to address climate change under the CAA[192] and that specific language in the provision requiring reciprocity determination can be met with respect to the 195 signatory countries of the UNFCC or a smaller subset.[193] It has also been argued that despite the provision's focus on state implementation plans, EPA could promulgate a national GHG emissions target and thereafter allocate to each state their respective "share" of emissions that are creating the endangerment.[194] Further, it is argued that these state plans could effectively be backstopped by federal implementation plans if necessary.[195]

This interpretation of the CAA is not without dispute. Some have argued that other provisions of the CAA are constrained to address emissions within the United States and that CAA 115 cannot be read to allow EPA to take whatever actions are necessary to address widespread air pollution outside of the country, but rather is limited to cross-border endangerment.[196] Other arguments have note that Congress would not have conveyed broad authority to EPA to regulate greenhouse gas air pollutants within CAA 115, noting the oft-quoted phrase that Congress . . . does not . . . hide elephants in mouseholes."[197] Finally, questions have been raised with respect to how EPA would ensure that any required SIP revisions would be in accordance with the limitation in §115 that the section only applies to a foreign country which provides reciprocal rights.

1.4. CAA §615 Authority of the Administrator (Title VI)

CAA §615 provides that if in the EPA Administrator's judgment, "any substance, practice, process, or activity may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere, and such effect may reasonably be anticipated to endanger public health or welfare, the Administrator shall promptly promulgate regulations respecting the control of such substance, practice, process or activity . . ." Therefore, the endangerment determination required under this section is distinctly different from endangerment provisions found in other parts of the CAA, including CAA §§111 and 202.

While EPA has cited CAA §615 in past rulemakings, the Agency, to date, has not made an explicit endangerment determination regarding GHGs under this authority.[198] A petition filed with the Agency in 2013 requested that the Agency issue a "public call for information . . . concerning the interaction between greenhouse gases and the stratosphere."[199] The petition also advocated for a market-based regulation for GHGs under title VI, arguing that EPA had such discretion under the language of §615.[200]

EPA has previously described 615 as "intended to augment other authorities and responsibilities established by Title VI."[201] In 2008, EPA also noted that it would need to "assess and analyze the available scientific information on the effect of GHGs on the stratosphere."[202] But at the same time, the Agency described the regulatory authority conveyed by the section as broad, potentially including the ability to establish a "cap-and-trade" program.[203] Given the relatively nascent state of EPA's utilization of/reference to CAA §615, however, relatively less academic and analytical attention has been paid to this authority. Some have noted that attempting to promulgate a broad regulatory program relying on CAA §615 "is relatively unlikely to survive legal challenge" on the same basis as critiques of the Agency's CAA §115 authority.[204]

2. Technical and Analytical Requirements

A number of views have been expressed with regard to the potential to effectively address climate change through the CAA. Some expressed or endorsed the view that EPA should view climate change as an existential challenge requiring the Agency to focus on key contributors to GHGs and use the full extent of its authority to forcefully reduce emissions in the near and longer-term. Others have agreed with the urgency of the need to act, but have indicated that it would be preferable for Congress to enact new legislation to direct the effort. Additional views have endorsed looking at GHGs as a co-pollutant under the CAA, because in many cases GHGs may be emitted as a byproduct of combustion EPA could approach control in conjunction with improving air quality in general.

Whatever overarching approach EPA takes to these issues, the Agency must improve its technical and analytical ability to analyze different approaches to address climate change. While the Agency has, in some sense, focused on relatively large sources of GHG emissions, over the longer term, EPA must assess alternative actions not only with regard to individual rulemakings but in connection with other efforts underway at different governmental levels and within industry. Specific areas of focus should include the following:

2.1. Role of Federal and State/Local Programs

State and local regulations to control GHG emissions have taken many forms. In California, Assembly Bill 32 ("AB32"), approved in 2006, required the California Air Resources Board to adopt GHG regulations to reduce such emissions to 1990 levels by 2020. The state currently has a 2030 target of a 40 percent reduction in GHG emissions by 2030, supported by a cap-and-trade rule and other initiatives regarding transportation, renewable energy, high global warming gases and a low carbon fuel standard. Other states are utilized Executive Orders and Memorandum of Understanding agreements to set GHG targets as well as employed renewable portfolio standards.

It is beyond the scope of this report to either list or analyze all such state or local initiatives. But the CAAAC work group identified as a significant issue the coordination of federal, state, and local GHG initiatives, including potential overlaps and inefficiencies. In this regard, CAA §116 provides that except as

otherwise preempted, the Act does not "preclude or deny the right of any State or political subdivision thereof to adopt or enforce . . . any standard or limitation respecting the emission of air pollutants [except with respect to CAA §§111 and 112, standards or limitations that are less stringent than applicable under those sections]. But whether or not state and local governments may act apart from federal efforts does not address the need to avoid conflicting or inefficient requirements involving the allocation of limited resources. EPA may not exceed its authority, but it need not duplicate efforts in an effort to simply exert its authority. It has been the traditional role of EPA to lead by example and EPA has access to considerably more technical and analytical resources than are available in individual states.

2.2. Lifecycle Accounting of GHG Emissions

CAA §211(o), Renewable Fuel program, contains provisions that explicitly define lifecycle greenhouse gas emissions for renewable fuels as well as the required minimum level of lifecycle emissions for different renewable fuels.[205] But there are no comparable provisions contained in other CAA authorities that have been identified as potential sources of authority for EPA to control GHGs.[206] This raises the issue with respect to how lifecycle emissions can or should be accounted for within future CAA GHG regulations and, if so, how to avoid duplicative regulation or inefficiency. EPA has assessed such information as part of current GHG reporting programs but has not explained how it will address this issue with respect to the exertion of its regulatory authority in any comprehensive manner.

2.3. Embedded/Embodied Carbon in Products

One facet of lifecycle accounting involves accounting for GHGs within finished products where different materials, manufacturing methods and transportation requirements may present different emission profiles for the same product. Some maintain that a granular assessment of embedded carbon is essential, for example, with respect to building materials where the "end product" may be relatively indistinguishable with respect to the energy requirements for maintaining the structure and its environs, but upstream emissions can be variable based on the materials chosen and related sourcing. For example, the accumulated carbon from battery production is an important consideration in the assessment of the impact of electric vehicles.[207] To the extent that lifecycle analysis is supported by the underlying statutory authority and appropriate within the context of GHG rulemakings, the issue arises as to how to ensure consistency in the regulation of different source categories for which different levels of information may or may not be available. To the extent that lifecycle emissions are modeled, additional issues arise with respect to modeling inputs and assumptions.

2.4. Creditable Offsets

A similarly difficult analytical issue to lifecycle analysis occurs with respect to the calculation and verification of creditable GHG offsets. In the context of the CAA, title IV of the Act provides a historical example concerning how offsets (in the form of allowances) may be created (by emitting less SO_2 than allowed) and then utilized by other sources (through purchasing SO_2 allowances) where it may have been less economically or technically feasible for a source to directly reduce emissions. Similar cap-and-trade/offset systems have long been discussed as a model for obtaining cost-effective GHG emission reductions.[208]

But the complexities of a GHG cap-and-trade system utilizing creditable offsets are considerably more complex than the task that EPA faced when promulgating regulations to implement the Acid Rain

program pursuant to detailed statutory authority approved as part of the 1990 Clean Air Act Amendments. While in some applications (*e.g.*, the utility sector) it could theoretically be relatively straightforward, other sectors lack contemporaneous monitoring for CO_2 and other GHGs. In addition, the ability of one sector to trade with another regulated sector through an allowance system raises multiple issues, including the relative cost of generating emission reductions, varying systems to "verify" credits and how to address the different atmospheric lifetimes of various GHGs. In addition, for offsets from other regulated as well as "non-regulated" sectors, the amount, origin[209] and "permanency" of offsets may be an issue.

2.5. Fuel Switching

We have already experienced fuel-switching in the electric generation sector where the consumption of coal for electric generation has substantially declined over the last decade, not only in the United States, but within the EU.[210] The issue of how the CAA may be utilized to require or incentivize fuel switching is complex and dependent on the specific authority sought to be utilized. The most apparent example of uncertainty in this area probably lies within the electricity generation sector, given the current uncertainty of the extent of CAA authority contained in CAA §111.[211] But fuel use issues can arise within other potential CAA §111 rulemakings and within the mobile source sector.

2.6. Interagency Cooperation

While the CAA addresses air pollutants, a general sentiment during CAAAC discussions was expressed that EPA should facilitate and be responsive to actions taken by other federal agencies and departments regarding GHGs and climate change, both from the perspective of avoiding duplication of effort and conflicting results.

Recommendations

1. EPA Should Reassess and Further Define its CAA Authority to Address GHGs and Climate Change

It has been 13 years since EPA comprehensively reviewed its authority to address GHGs under the CAA and solicited public comment on same. In this time, the Agency has been able to move forward with a series of rules regarding the mobile source sector addressing light, medium and heavy-duty on-road vehicles and many types of commercial aircraft. During the same time period, however, the Agency has been unable to implement GHG standards for existing fossil fuel-fired powerplants.[212] Regulations to address methane from oil & gas operations have also been in flux.[213] And regulations controlling HFCs in a comprehensive manner are still in the process of regulatory development (currently relying on statutory authority outside of the CAA).

This is not to criticize the Agency's efforts, or to ignore that differing policy approaches that were adopted by different Administrations -- much less the often-intricate legal issues that can attend to CAA rulemaking. But on a fundament level, it is evident that a considerable amount has changed since the EPA's initial assessment of its CAA legal authority following *Massachusetts v. EPA*. EPA's CAA rules addressing GHGs have been both upheld and vacated by the courts and the scope, sufficiency and legal defensibility of future CAA rulemaking simply cannot be assumed. Therefore, the first recommendation is

that EPA conduct a new, public review of its CAA authority to address GHGs based on its experience over the last decade and soliciting additional public opinion on the most productive approach for the Agency to take in the coming decade. At minimum, this review should include the CAA authorities identified above in section 1 of "Challenges."

1.1. EPA Should Issue a New ANPRM of Similar Public Document Analyzing Available CAA Authority to Address GHGs Under the CAA and Soliciting Public Comment.

1.1.1. EPA Should Reexamine Authority Pursuant to CAA 108, 109, 111, 112, 615.

On January 19, 2021, EPA denied three long-filed petitions to the Agency requesting that EPA regulate GHGs pursuant to its authority to set NAAQS under CAA §§108 and 109,[214] to address GHGs pursuant to pursuant to CAA §115 and to regulate GHGs as a hazardous air pollutant under CAA §112. On March 4, 2021, EPA in a short notice indicated that it was withdrawing these determinations. Both efforts are woefully insufficient to fully address the challenge of climate change and the serious issues that underlie EPA's legal authority to address GHGs under the CAA.

With respect to the January 19, 2021 determination, much of the analysis of the petitions is frankly cursory and based on a mix of legal and policy arguments. Significant portions of the determination also rely on comments filed by other agencies in connection with EPA's July 2008 ANPRM, which were notably not views that were fully analyzed nor adopted by the Agency.[215] Thus, the analysis underlying the denial is not only 13 years old, it also does not reflect the full breath of EPA's analysis of its available authority in the multiple rulemakings it has undertaken since *Massachusetts*. With regard to EPA's withdrawal of the denial of the petitions addressed in the January 19, 2021 determination, the Agency's response is even more severely limited. EPA indicated only that the "agency did not fully and fairly address issues raised by the petition."[216] But EPA gives no indication of what specific information gaps exist nor how it specifically considered the process by which the initial determination by the Agency was made to be "unfair." The Agency gave no hint as to what procedural defects were the source of the unfairness, nor what issues may have been addressed and what issues not.

Given the enormity of the issue – and the importance to many sectors of the economy and many members of the public as to how EPA will seek to address on climate change, the Agency should not leave core legal issues – in some cases raised with the Agency over 20 years ago[217] – unaddressed or addressed in a piecemeal fashion. Rather, the EPA should undertake a new review, in a public fashion, of the extent of its authority under the CAA to address GHGs. Whether this takes the specific form of an ANPRM or not is not the important issue. The issue is that CAA authority in the area of GHGs and climate change should be fully expressed, even where such analysis may reveal limits to that authority. The present uncertainty over the extent of that authority, how and when EPA may or may not utilize different authorities and how the Agency may address issues concerning smaller sources and/or de minimis emissions have either not been fully vetted nor fully expressed by EPA under several past Administrations, despite Supreme Court decisions affirming both the Agency's authority to regulate GHGs as "air pollutants" and interpretation that this authority is context-specific.[218]

CAAAC would understand that this may be contrary to long-standing practice, that the Agency rarely if ever describes the limits of its potential legal authority. But both the extent and the limits to CAA authority are vital to a full understanding of what actions may or may not be taken and what additional legal authority may or may not be needed by EPA or other parts of the government. In essence, there is

no longer any benefit to the Agency or the public in keeping one's powder dry on important legal issues affecting climate.

In connection of this review of EPA's legal authority under different provisions of the CAA, the Agency should also detail and examine relevant policy issues. For example, with regard to a GHG NAAQS, how the "cooperative federalism" structure of the Act would be implemented should be explored. Fundamentally, whether or not a primary or secondary NAAQS is utilized, responsibility for planning how to achieve attainment is relegated to the states. Thus, questions of adequate resources, planning tools and the ability to undertake different approaches to develop acceptable SIPs must be examined. EPA does not avoid these issues if it attempted to utilize CAA §115. Similar findings of SIP inadequacy would be triggered and perhaps complicated by provisions providing for the participation of foreign countries at public hearings concerning "any revision of the appropriate portion of the applicable implementation plan."[219]

Other policy issues arise in connection with the exertion of other authorities. Specifically, it is not clear whether EPA may utilize fees or other economic measures in order to implement CAA provisions, apart from specific authority contained in CAA §110.[220] Cap and trade mechanisms have been used with regard to certain programs such as interstate air pollution control efforts, but apart from Title IV, explicit authority is again lacking at least in some parts of the CAA. EPA therefore should explore policy issues involved with utilizing different approaches to addressing climate change under the CAA and whether these policy outcomes would be more or less beneficial that other options, including options for additional legislative authority.

1.2. EPA Should Clearly Articulate What Implementation Methodologies May Be Available to Include Cap-and-Trade, Financial Mechanisms, and Incentive Programs

As expressed through this report, there are numerous law review articles and opinion pieces that define a preferred option for the control of GHG emissions. While outside the scope of this report, adding a price to carbon has long been a topic of academic and political discussion. But within the confines of the CAA, EPA should articulate what available regulatory mechanisms exist in terms of authority to utilize emission allowances in cap-and-trade regime or other market or financial mechanisms, specifically with respect to the identified CAA sections for GHG regulation. CAAAC would recognize that questions concerning the extent of EPA authority will inevitably arise in these areas and that, in some areas, there may not be existing caselaw to serve as guidance to the Agency. But EPA should strive for transparency at the possible price of expediency.

1.3. EPA Should Define How Implementation of CAA Authority Can Occur in Connection with Authority and Programs Available to Other Federal Departments and Agencies

Other federal department and agencies have both legal authority and funding to take steps to address GHGs and climate change. Examples are numerous and will not be recounted in this report. The Department of Energy has multiple programs to fund both energy efficiency efforts as well as longer-term research and development of breakthrough energy technologies. The Department of Transportation has authority with respect to fuel economy standards and federal highway projects that can promote better use of energy resources devoted to moving people and goods. Department of Agriculture programs can have important impacts on land use and carbon sequestration.

While interagency cooperation and coordination exists within many spheres of the Executive Branch, it is also true that interagency conflict and competition can also exist. This has occurred in the past both with respect to energy efficiency standards and mobile source regulations, but can extend into other areas, including renewable fuels and energy projects. Obviously, there is no one easy solution to intergovernmental coordination. But this issue should be recognized as a potential source of inefficiency – and in some cases a cause of delay or deferral. To the extent possible, we would urge EPA to be proactive in this area and identify areas of potential conflict and cooperation regarding GHGs and climate.

2. EPA Should Continue to Focus on Major Sources of GHGs

2.1. Following Promulgation of the Clean Power Plan and Affordable Clean Energy Rule and Related Litigation, EPA Needs to Refocus Efforts on Electric Power Generation

In the last 7 years, EPA has proposed two different approaches to regulating GHGs from existing EGUs pursuant to CAA §(d),[221] and the Agency has finalized two different rules.[222] These rules were generically known as the Clean Power Plan and the Affordable Clean Energy Rule. Intensive litigation occurred with respect to both rulemakings which will not be recounted or explained in any detail in this report. However, as a result of litigation in the D.C. Circuit, the Affordable Clean Energy Rule was vacated as well as that rule's repeal of the Clean Power Plan.[223] The EPA subsequently requested that the court issue a partial mandate in this litigation, with the net result that the court's vacatur of EPA's repeal of the Clean Power Plan is currently stayed to allow EPA to engage in new rulemaking. Thus, at present, the Agency is in some sense back to step 1 with regard to the issue of regulating GHGs from existing fossil fuel-fired EGUs under the authority of the CAA; no current rule for existing sources is in effect.

As noted earlier, this regulatory/litigation impasse has not prevented the reduction in actual emissions of GHGs from EGUs. EPA estimates that GHG emissions from electric generation in 2019 comprised 25% of U.S. GHG emissions and 31% of CO2 emissions. Between 2005 and 2019, CO2 emissions from electric generation declined by 19%.[224] But at 25% of overall GHG emissions, electric generation ranks roughly on par with emissions from transportation (29%) and industry (23%).[225] The issue going forward is how EPA will address GHG emissions from this major sector using the CAA.

Opinions of CAAAC members vary with regard to EPA's authority pursuant to CAA §111(d) and the extent to which states may vary implementation relative to EPA guidelines concerning existing EGUs. General agreement, however, may be found to exist with respect to the promulgation of legally defensible guidelines for existing sources. Given the lengthy litigation history of CAA §111(d), it should be evident that newly proposed rules be firmly grounded in statutory analysis and backed by thorough Technical Support Documents. In brief, we would advise the Agency what while the importance of controlling existing EGUs is evident by their sizeable share of overall U.S. GHG emissions, it would be unproductive for the Agency to enter a third round of CAA §111(d) guidelines and associated Federal Implementation Plans that was not firmly rooted in available authority.

2.2. Engine and Vehicle Standards Should Continue to Utilize Flexible Credit Programs

The situation confronting EPA is different with regard to mobile source emission standards. As outlined above, EPA has successfully promulgated five rules addressing GHGs from light, medium and heavy-duty

vehicles and aircraft engines. All rules became legally effective and, in some cases, have been implemented by EPA and the National Highway Traffic Safety Administration ("NHSTA") for over a decade. Light duty GHG standards have been in place since MY 2011 and medium and heavy-duty standards since 2014.

CAAAC is cognizant of issues involving the Safe Affordable Fuel-Efficient Rule and the fact that this rule partially replaced more aggressive light duty standards for MYs 2021-2025 contained in the National Program promulgated in 2012. (More detailed discussion of issues for mobile sources may be found in the CAAAC's mobile source emission section). CAAAC would note, however, that legal uncertainty is not confined to CAA §111 and stationary source rules despite the Agency's relative success in either avoiding or surviving judicial review in the area of mobile sources generally.

CAAAC would therefore advise that EPA continue to implement title II emission standards using flexible compliance measures that do not provide inordinate incentives to specific technologies. While various rulemakings have utilized credit incentives for new and developing technologies (*e.g.*, advanced vehicle credits) EPA should be well aware that numerous policy issues can arise in this area. Given the relatively lengthy process ahead, similar to the electric utility generation sector, EPA should strive for legal defensibility and broadly achievable standards that allow individual regulated parties to address the substantial technical challenges that may lie ahead.

2.3. EPA Should Address Industrial Sources in Coherent and Transparent Manner

Outside of EGUs, EPA has promulgated NSPS for municipal solid waste landfills and new, modified, and reconstructed oil and gas well sites, gathering and boosting stations, processing plants and compressor stations. EPA also finalized revisions to these rules, which have recently been vacated.[226] Currently over 60 source categories and subcategories exist for which EPA has finalized NSPS.

The CAAAC is aware that EPA has a degree of discretion concerning the "manner, timing, content and coordination of its regulations with other agencies."[227] CAAAC is also aware that EPA has generally sought to address the larger CAA §111 source categories first. However, EPA has not articulated a plan, or even a general outline as to how it intends to approach the longer-term regulation of industrial sources under its available CAA §111 or other authority in the CAA. Given the relative size of industrial sources, EPA should articulate what specific approaches, policy perspectives and industrial source categories it intends to address, in what timeframe and to what intended degree of stringency.

3. EPA Should Define How Implementation of CAA GHG Programs Can Occur in Connection with State and Local Programs Designed to Address GHG Emissions, Including Potential Conflicts

State initiatives in the area of GHGs are nothing new. The Regional Greenhouse Gas Initiative ("RGGI") was initiated by 10 Northeastern states in 2005. There were also efforts in the Midwest and West in subsequent years to establish multistate agreements to guide GHG emission reductions. New coalitions have been formed with Memorandum of Agreement on such issues as the level of powerplant regulation and adoption of new vehicle standards. We have previously cited California's long-standing statutory and highly developed regulatory mechanisms.

As the regulation of GHGs in the United States "matures" at levels other than the federal government, EPA should define how its actions under the CAA can occur in conjunction with state and local programs, and/or in a manner in which regulatory overlap is reduced. States retain authority under CAA §116 to promulgate standards that may be more stringent than those EPA promulgates under the CAA. In some cases, however, it may be more efficient for EPA to promulgate national standards, rather than hazard a state-by-state piecemeal approach. In other areas, states and localities may be more able to address the needs of their localized environment and economies. It would appear improbable for EPA to predict all future state and local actions in this area, much less analyze how conflicts can be avoided in every instance. But it would be helpful for the Agency to articulate a set of policies and approaches, in specific related to its ongoing GHG rulemaking process, that better define how it will approach this issue.

4. EPA Should Consider Regulatory Mechanisms Which Can Incentivize Behavior

During CAAAC discussion of this section, a recommendation was made that EPA should consider regulatory mechanisms which can incentivize behavior. EPA has utilized many different mechanisms to reward early actors in other CAA programs, e.g., allowing for additional credits for innovative technologies or the accumulation of credits for use at later stages of an emission control program. These mechanisms were noted above with regard to mobile source programs, but could also be extended to other sectors.

5. EPA Should Issue A NODA Regarding Measurement and Accounting Methods for GHG Emissions, Including Lifecycle Emissions and Embodied Carbon

In discussions concerning this section, CAAAC members stressed the need for clear accounting rules for lifecycle emissions and the need to coordinate EPA's activities with that of other agencies, including the Department of Energy. To the extent that lifecycle emissions are accounted for and addressed in EPA rulemakings, the agency's approach should be consistent with that employed by other elements of the federal government. Threshold issues exist with regard to how lifecycle emissions accounting should be conducted and any differences in approach should be resolved in interagency discussion and agreement prior to the promulgation of rules.

In addition, the subject of GHGs (*e.g.*, carbon) embodied in products was also discussed. This issue can occur both with respect to domestic and imported products, but concern was expressed that U.S. companies not be placed as disadvantage through the importation of products that may be subject to less rigorous accounting of their overall impact on GHG emissions. Embodied carbon is a term that is often associated with building materials, but the issue of accounting for GHG emissions associated with products also has a broader context.

CAAAC recognizes that these issues may present the Agency with difficult technical challenges and that approaches may indeed vary over time (*e.g.*, as modeling is revised and enhanced). CAAAC also recognizes that this is an area where academic dispute may arise; there may be legitimate debate concerning the validity of different approaches. But CAAAC believes that EPA should embrace the challenge and create an open discussion of alternatives through a Notice of Data Availability or similar public effort.

6. EPA Should More Explicitly Address Expected Co-Benefits from Controlling Criteria and Other Non-GHG Air Pollutants

During CAAAC discussion of this section, a recommendation was made that EPA should explicitly address the co-benefits from controlling criteria and other non-GHG air pollutants.

7. EPA Should Proactively Address Potential GHG Issues with Respect to Imported Products

During CAAAC discussion of this section, a recommendation was made that EPA should address GHG issues with respect to products imported into the United States. Similar to issues above in paragraph 5, EPA would need to resolve issues -- in different contexts with regard to different products -- as to how lifecycle impacts would be assessed.

8. EPA Should Enhance Web-Based Information on GHG Standards to Include Full Regulatory History and Supporting Documents

EPA's adjustments to its website have not always promoted transparency. In some cases, information has been made more difficult to find. EPA should reconstitute its internet presence with an emphasis on not only present current regulatory efforts and policies, but with regard to providing a public resource for retrieval of prior EPA legal, policy and regulatory documents addressing GHGs. All prior proposed rulemakings, final rules and technical documents should be easily accessible and archival policies should be examined.

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[145] DRAFT Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990-2019, EPA 430-R-21-001 at ES-5.
[146] Some estimates predict a 10.3% drop in GHG emissions in 2020. *See* https://rhg.com/research/preliminary-us-emissions-2020/, last accessed on 4/11/2021.
[147] Draft Inventory.
[148] For example, Clean Air Act section 111(d) requires EPA to utilize a procedure under which each state submits a plan to establish standards of performance for existing sources and states may take into consideration the remaining useful life of existing sources.
[149] The authors of this report acknowledge that the full extent of this authority has been and will most likely be subject to further definition, either through additional CAA rulemaking, litigation or a combination of both. Other environmental and energy statutes have been and may also be utilized to address GHGs, among them the National Environmental Protection Act, the Clean Water Act, various waste laws and comprehensive energy legislation such as the Environmental Policy Act of 2005, the Energy Independence and Security Act of 2007 and legislation to control hydrofluorocarbons contained in the Comprehensive Appropriations Act, 2021.
[150] In addition, some provisions of the 1990 amendments, such as section 812 which provided for the monitoring of carbon dioxide emissions from powerplants, were not incorporated into the CAA itself.
[151] P. Law 110-161, Consolidated Appropriations Act, 2008 provided $3.5 million for promulgation of a rule "to require mandatory reporting of greenhouse gas emissions above appropriate thresholds in all sectors of the economy of the United States." Associated report language directed the Agency to utilize its existing authority under the CAA for the rulemaking.
[152] Section 812 was approved as part of the 1990 Clean Air Act Amendments, but was not codified as part of the Clean Air Act, 42 U.S.C. §7401 et seq.
[153] The Benefits and Costs of the Clean Air Act, 1970 to 1990 at ES-8.
[154] *Id.* at ES-9, Table ES-5.

[155] The Benefits and Costs of the Clean Air Act: 1990 to 2010; The Benefits and Costs of the Clean Air Act from 1990 to 2020, Final Report, April 2011.
[156] The central estimate indicated $12 trillion in monetized net benefits from 1990 to 2020. Final Report at 2 (Abstract).
[157] Regulatory Impact Analysis are required and have been generated in connection with individual CAA rulemakings, but such analyses do not assess all possible alternatives.
[158] We would note that EPA has estimated the "social cost of carbon" for purposes
[159] *See* https://www.eia.gov/electricity/data/browser.
[160] *See, e.g.,* EPA's Estimated 2017-2025 Model Year Lifetime Discounted Costs, Benefits and Net Benefits Assuming the 3% Discount Rate SCC Value. 77 Fed. Reg. at 62,629 (Oct. 15, 2012).
[161] Climate Change 2014 Synthesis Report,
[162] Fourth National Climate Assessment, Volume II, Summary Findings.
[163] *Id.*
[164] Section 821 did not amend the CAA, nor was it codified as part of the CAA.
[165] Cannon memo at 4.
[166] *Id.* at 6.
[167] EPA's Authority to Impose Mandatory Controls to Address Global Climate Changed under the Clean Air Act, Robert E. Fabricant, August 28, 2003.
[168] For example, the Green Power Partnership for electricity from renewable sources, the GreenChill program to promote supermarket refrigeration technologies that lower emissions and reduce GHGs, the Combined Heat and Power Partnership and other programs to voluntarily reduce methane emissions still exist.
[169] 80 Fed. Reg. 64,662 (Oct. 23, 2015).
[170] 84 Fed. Reg. 32,520 (July 8, 2019)
[171] See *American Lung Association v. EPA*, No. 19-1140 (D.C. Cir. 2021).
[172] 80 Fed. Reg. 64,510 (Oct. 23, 2015).
[173] EIA monthly energy review environment section: https://www.eia.gov/totalenergy/data/monthly/#environment
[174] See 74 Fed. Reg. 56,260 (Oct. 30, 2009). These rules and follow-on rules to cover additional sectors are contained in 40 C.F.R. Part 98.
[175] See FY 2008 Consolidated Appropriations Act, 121 Stat. 1844, 2128 (2008).
[176] EPA has proposed rules to implement the American Innovation and Manufacturing Act of 2020, Consolidated Appropriations Act of 2021, Section 103. EPA has previously utilized authority contained within CAA section 612 to regulate HFCs in certain end uses, albeit some provisions of rules previously promulgated were vacated as a result of litigation in the D.C. Circuit.
[177] For example, pursuant to CAA §202(C) standards applicable to heavy duty engines must apply for no less than 3 years and include 4 years of "lead time."
[178] In some cases, EPA has disclaimed the authority to reduce air pollutants to zero levels. For example, EPA does not believe it has the authority to set a zero NAAQS, in part, because such a level would be practicably impossible to meet. "The CAA does not require the Administrator to establish a primary NAAQS at a zero-risk level or at background concentration levels." 73 Fed. Reg. at 66,966 (Nov. 12, 2009), *citing Lead Industries Association v. EPA*, 647 F. 2d at 1156 n.51.
[179] "[T]he Administrator shall publish, simultaneously with the issuance of any such criteria and information, proposed national primary and secondary ambient air quality standards . . ." CAA §109(a)(2).
[180] CAA §109(b)(1), (2).
[181] *See* generally, CAA §110.
[182] See, e.g., Revisting the NAAQS Program for Regulating Greenhouse Gas Emissions under the Clean Air Act, Duke Nicholas Institute, January 2017 at 23.
[183] Letter from Administrator Wheeler to Center for Biological Diversity, Institute for Policy Integrity, Good and Water Watch and the David Brower Center, January 19, 2021; Letter from Acting Administrator Nishida to Center for Biological Diversity, March 4, 2021.
[184] Returning to Clean Air Act Fundamentals: A Renewed Call to Regulate Greenhouse Gases Under the National Ambient Air Quality Standards (NAAQS) Program, Georgetown Envtl. Law Review 233 (2019), Howard R. Crystal, Kassie Siegel, Maya Golden-Krasner and Claire Lakewood, Georgetown Envtl. Law Review 233 (2019) at 262-264
[185] *Id.* 264-266
[186] *Id.* 266-271.
[187] Whitman v. American Trucking Assoc. Inc., 531 U.S. 457 (2001)

[188] "At least three major difficulties would be presented with respect to the issuance by EPA of a NAAQS for one or more greenhouse gases: (1) The determination of what GHG concentration level is requisite to protect public health and welfare; (2) the unique nature of GHGs as pollutants dispersed from sources throughout the world and that have long atmospheric lifetimes; and (3) GHG concentrations in the ambient air are virtually the same throughout the world meaning that they are not higher near major emissions sources than in isolated areas with no industry or major anthropogenic sources of GHG emissions. Whatever level EPA might eventually establish as an acceptable NAAQS for one or more GHGs, EPA's setting of such a level would immediately implicate further issues under the NAAQS regime, including the ability of States and localities to meet such a standard. If the GHG NAAQS standard for one or more gases is set at a level below the current atmospheric concentration, the entire country would be in nonattainment." 73 Fed. Reg. at 44,367.
[189] Can and Should Greenhouse Gases Be Regulated As Hazardous Air Pollutants Under Clean Air Act Sect. 112?, Mark Bond, Sabin Center for Climate Change Law, Columbia University, June 2015.
[190] Greenhouse Gas Regulation Under the Clean Air Act, Structure, Effects, and Implications of a Knowable Pathway, Nathan Richardon, Art Fraas, Dallas Butraw, Resources for the Future, April 2010 at 23-4.
[191] 73 Fed. Reg. at 44,494.
[192] Combatting Climate Change With Section 115 Of The Clean Air Act, Law and Policy Rationales, Sabing Center for Climate Change Law, Chapter 2: The Legislative History of Section 115, Philip Barnett.
[193] Legal Pathways to Reducing Greenhouse Gas Emissions Under Section 115 of the Clean Air Act, Michael Burger, Ann E. Carlson, Michael B. Gerrard, Jayni Foley Hein, Jason A. Schwartz and Kenneth J. Benes, Georgetown Envtl. Law Review, Vol. 28:359 at 376-377.
[194] *Id.* at 401.
[195] *Id.* at 404-408.
[196] *Section 115 is not a viable climate policy option*, Niskanen Center, accessed at: niskanencenter.org. This posting also argued that courts could limit CAA 115 to situations where a NAAQS had been established.
[197] See The Elephant in the Room of the Elephant in the Mousehole? The Legal Risks (and Promise) of Climate Policy under §115 of the Clean Air Act, Nathan Richardson, Resources for the Future, citing Whitman v. Am. Trucking Ass'ns, 531 U.S. 457, 486 (2001).
[198] This would include CAA authority that existed prior to the enactment of CAA §615 in 1990. CAA §157(b) of the CAA was enacted in 1977, but subsequently displaced when Congress approved title VI as part of the 1990 Clean Air Act Amendments.
[199] Petition for Rulemakings and Call for Information under Section 115, Title VI, Section 111, and Title II of the Clean Air Act to Regulate Greenhouse Gas Emissions, Institute for Policy Integrity, February 19, 2013.
[200] *Id.* at 17.
[201] 73 Fed. Reg. at 44,519.
[202] Id.
[203] *Id.* In the 2008 ANPRM, EPA also noted that CAA §612 provided authority to review alternatives to ozone depleting substances and approve substitutes. As noted above, EPA subsequently promulgated regulations under this authority to end certain uses of HFCs. The extent of EPA's authority under this Title VI provision is still an open question following D.C. Circuit litigation, but in any event, it would be limited to substitutes for ozone depleting substances, constraining its potential reach to address climate change.
[204] Greenhouse Gas Regulation under the Clean Air Act at 15.
[205] CAA §211(o)(1).
[206] In the context of the GHG Reporting Rule, EPA was directed to include both upstream and downstream GHG emissions "as appropriate." Joint Explanatory Statement, FY 2008 Consolidated Appropriations Act, Pub. L. 110-161 (2008).
[207] Effect of battery manufacturing on electric vehicle life-cycle greenhouse gas emissions, International Council on Clean Transportation, February 2018.
[208] There has also been a substantial debate with regard to EPA's legal authority to promulgate such systems under the different potential CAA authorities cited above.
[209] For example, legislation to authorize a broad economy-wide approach to GHG emissions (the American Clean Energy and Security Act) contained provisions allowing for both domestic and international offsets, subject to a limit on the volume of each.
[210] Share of coal-fired generation in total electricity generation, 2010-2019, iea.org.
[211] See, e.g., *American Lung Association v. EPA*, No. 19-1140 (D.C. Cir. 2021).
[212] Without recounting the full litigation history, final rules to regulate GHG emissions from existing fossil fuel-fired EGUs were promulgated in 2014 (Clean Power Plan), subsequently stayed by the Supreme Court, repealed and the replaced by the

Affordable Clean Energy rule, which rule was subsequently vacated by the D.C. Circuit. *See* further discussion in sec. 1.2, *infra*. Thus, at present, there are no CAA regulations defining specific limits for GHG emissions from existing EGUs, albeit standards remain in place for new units and GHG emissions may be considered, on a case-by-case basis, during the PSD permitting process.

[213] Subpart OOOO standards were finalized in 2016. 81 Fed. Reg. 35,824 (June 3, 2016). This rule was subsequently amended in 2020 to rescind volatile organic chemical provisions applicable in the transmission and storage segment and methane requirements for the production and processing segments. Requirements may be subject to further change following a Senate vote to rescind the 2020 rule. S.J. Res. 14.

[214] The petition additionally requested EPA to assist states with addressing GHGs under CAA §110.

[215] "This document summarizes much of EPA's work and lays out concerns raised by other federal agencies during the review of this work. EPA is publishing this notice today because it is impossible to simultaneously address all the agencies' issues and respond to our legal obligations in a timely manner." 73 Fed. Reg. at 44,355.

[216] March 4, 2021 Letters from Acting Administrator Jane Nishida to various petitioners.

[217] We would note that one petition denied by EPA in January was sent to the Agency in 2009. This means that it was pending at the Agency through nearly three full Presidential terms without a response. Other petitions filed with EPA during 2007 and 2009. The 2008 ANPRM noted that there were seven petitions received in the months prior to publication. 73 Fed. Reg. at 44,396.

[218] Massachusetts, cited supra; Utility Air Regulatory Group v. EPA, 573 U.S. 302 (2014).

[219] CAA §115(b).

[220] *See, e.g.,* 73 Fed. Reg. at 44,411.

[221] Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 79 Fed. Reg. 34,840 (June 18, 2014); Federal Plan Requirements for Greenhouse Gas Emissions From Electric Generating Units Constructed On or Before January 8, 2015; Model Trading Rules; Amendments to Framework Regulations, 80 Fed. Reg. 64,966 (Oct. 23, 2015); Emission Guidelines for Greenhouse Gas Emissions From Existing Electric Utility Generating Units; Revisions to Emission Guideline Implementing Regulations; Revisions to New Source Review Program, 83 Fed. Reg. 44,746 (Aug. 31, 2018).

[222] Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662 (Oct. 23, 2015); Repeal of the Clean Power Plan; Emission Guidelines for Greenhouse Gas Emissions from Existing Electric Generating Units; Revisions to Emission Guidelines Implementing Regulations, 84 Fed. Reg. 32,520 (July 8, 2019).

[223] American Lung Association v. EPA, No. 19-1140 (D.C. Cir., Jan. 19, 2021)

[224] *See* https://www.eia.gov/environment/emissions/carbon.

[225] *See* https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.

[226] Environmental Defense Fund v. EPA, D.C. Circuit, No. 19-1222.

[227] *Massachusetts v. EPA*, 127 S.Ct. at 1462.

Acid Rain

Overview

As referenced in other segments of this report, the 1970 Clean Air Act provided EPA with multiple tools to address ambient air quality issues as well as major stationary sources and mobile sources. But the 1970 Act, like many enactments, was a product of its time, reflecting prevailing considerations when it was approved by Congress. In the early to mid-1980s, concerns grew over the effects of lake and stream acidification, particularly in the Northeast and forested areas of the Mid-Atlantic and Southeast. EPA research indicated that the national average pH level of rainfall in 1980 was 4.6, rather than the 5.6 level associated with normal rainfall.[228] The National Acid Precipitation Program ("NAPAP") was formed and efforts to more comprehensively monitor surface water and soils began in earnest.[229] The net result of these efforts, along with multiple Congressional hearings during the 1980s and increased public attention to the issue was Title IV of the Clean Air Act, enacted as part of the 1990 Clean Air Act Amendments and designed to greatly limit acidic deposition from air emissions that, in many cases, were generated from hundreds of miles away.

Title IV was the product of a vigorous Congressional debate and legislative negotiation in order to bridge the gaps between different regions of the country. Notably, however, this intensive process provided the first explicit authority for EPA to implement emission controls utilizing a "cap and trade" system. In doing so, Congress provided EPA with explicit timetables and legislative instructions with regard to how the program was to be implemented. Specifically, defined allowances were allocated for new and existing electric generating units ("EGUs"). Phase 1 of the program identified individual EGUs and the specific number of sulfur dioxide ("SO_2") allowances that would be allocated to each.[230] Phase II of the program provided specific formulas for SO_2 allowance allocations as well as allowance 'set-asides" for different groups of EGUs.[231] Limitations on the emission on NOx from affected units was varied in stringency according to different types of utility boilers.[232] And detailed provisions were provided regarding permits, compliance plans and penalties for excess emissions.

Fundamental to the acid rain program was one long legislative paragraph describing the "nature of allowances."[233] In brief, an allowance was specified to mean an authorization to emit sulfur dioxide in accordance with the provisions of Title IV. Thus, rather than authorizing EPA to prohibit or limit emissions based on statutory criteria, EPA was required to allocate an authorization to emit sulfur dioxide from "covered sources" up to specific statutory caps that applied in 1995 and 2000. Equally important to this statutory scheme, was the ability of an allowance recipient to "receive, hold, and temporarily or permanently" transfer allowances.[234] This latter element was explicitly designed to promote the most cost-effective reductions in air pollution among sources addressed by the acid rain program.

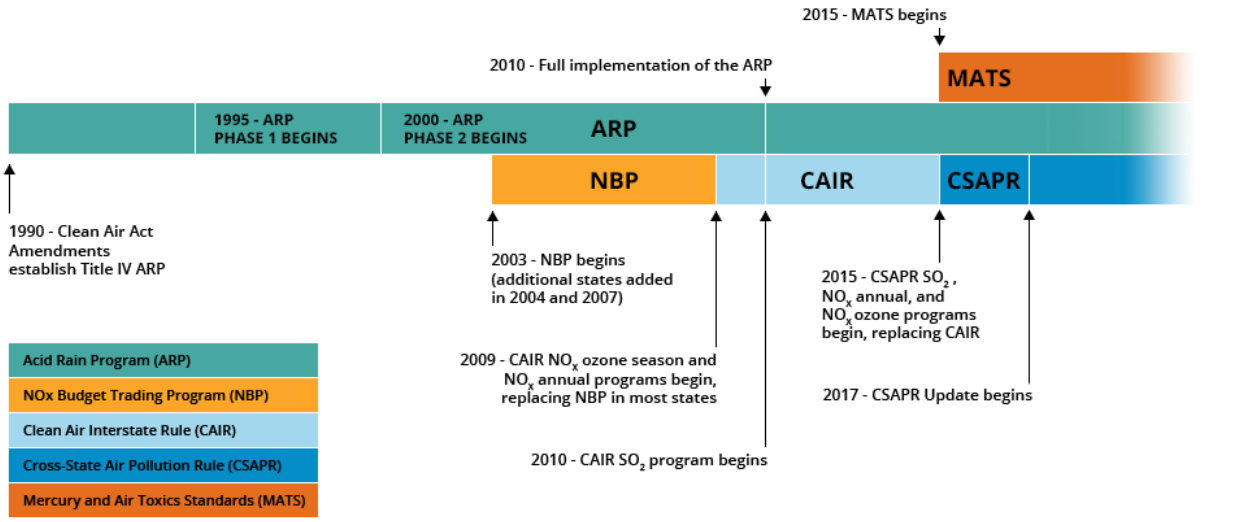
Successes

Since 1995, EPA has annually reported on the results of the acid rain program.[235] The very first report issued indicated 100% compliance and determined that actual emissions were 39 percent below the allowable emission level specified for Phase 1.[236] Reports in subsequent years echoed these results. A report in 2000 coinciding with the start of Phase 2, noted that SO_2 emissions were 11.20 million tons as

compared with a 1980 level of 17.30 million tons.[237] By 2010, SO_2 emissions from affected sources had dropped to 5.722 million tons.[238]

By the mid-2000s, reductions achieved by the acid rain program began to be "supplemented" by interstate transport rules promulgated pursuant to EPA's authority in section 110 of the Clean Air Act. These rules, described elsewhere in this report, imposed state SO_2 and NOx emission caps on approximately two-dozen states in the eastern half of the United States. In addition, emission controls installed on coal-fired units in order to comply with the Mercury Air Toxics Standards Rule ("MATS"), as well as the shutdown of numerous coal-fired units prior to the implementation of MATS, also reduced SO_2 emissions as a "co-benefit."

Figure 8. History of the ARP, NBP, CAIR, CSAPR, and MATS



As a result of these programs in combination with Title IV, covered units in 2019, emitted only 954,000 tons of SO_2 or approximately 10.6% of the allowable 8.95 million cap in SO_2 applied during Phase 2 of the program.[239] Compared with EGU SO_2 emission levels in the late 1970s to early 1980s, this represented an approximate 95% decline. The results are graphically represented below:

Figure 9. Three-Year Average of Total Sulfur Deposition

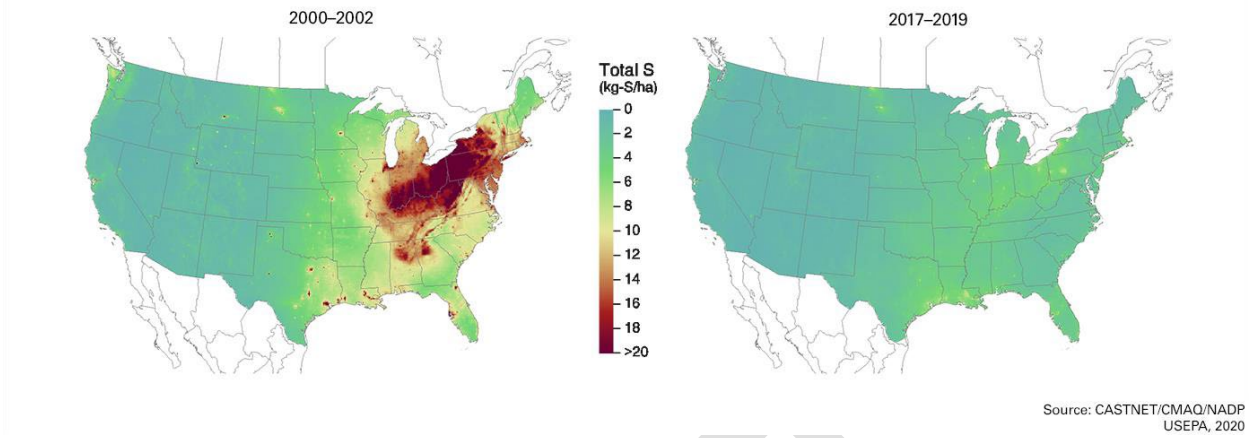
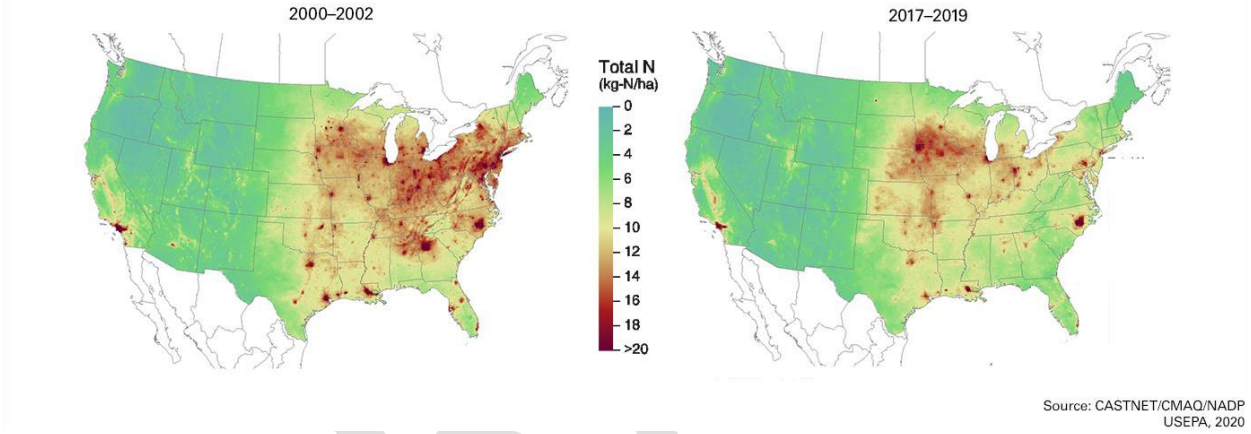


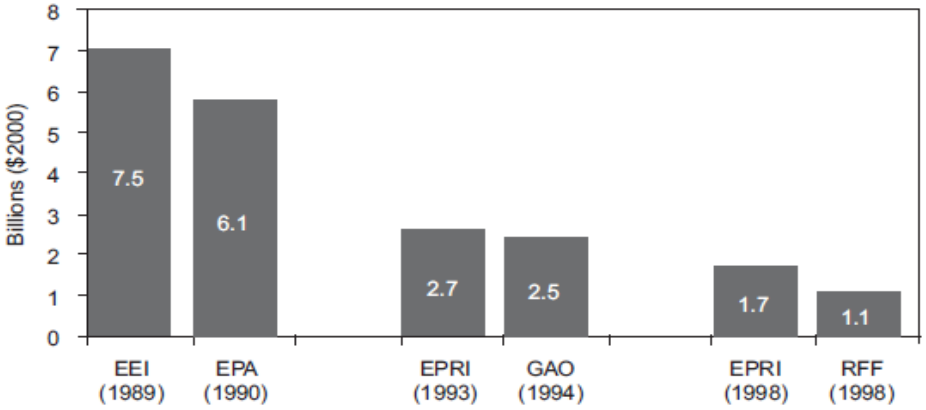
Figure 10. Three-Year Average of Total Nitrogen Deposition



Other air quality ecological system impacts are detailed in EPA's most recent report on power sector programs.[240]

A notable success of the acid rain program was its overall policy, implementation, and economic efficiency. The program was implemented on time with demonstrable results. This may be attributable to several factors. First, as a result of the detailed legislative language contained in Title IV of the Clean Air Act, there was virtually no significant litigation involving implementation of the program. This itself is significant given that most major Clean Air Act rules have been subject to lengthy litigation in the U.S. Court of Appeals (D.C. Circuit) and other courts. Second, there were limited enforcement actions initiated or required. The allowance-based trading program, literally run by a few EPA staff within the Clean Air Markets Division, relied on electronically reported data from sophisticated monitoring devices. Third, given the long time frames specified and the certainty of emission reductions required, affected sources were able to plan compliance strategies well in advance, whether they involved the installation of pollution control equipment or the purchase of allowances. As a result, the entire cost of the program decreased substantially over time.[241]

Figure 11. Evolution of Cost Estimates for Implementing Title IV Acid Rain Program, 2010



Source: These estimates are adapted from NAPAP (2005, 13); "EEI": Edison Electric Institute; "GAO": U.S. General Accounting Office (now Government Accountability Office). The other abbreviations are defined in the text.

Future Challenges and Opportunities

From one perspective, the acid rain program could be considered to be a victim of its own success. While there was considerable concern at the time of enactment regarding the overall stringency and cost of the program, by around 2012, prices for SO_2 allowances decreased dramatically.[242] Thus, at a certain point in time, the existence of the program did not dictate additional behavioral responses, resulting in further reductions in EGU emissions. This perspective, however, fails to take into account the impact of the program on initiating a broad-based downward trend in SO_2 and NOx emissions from EGUs and in enabling the utilization of subsequent "cap and trade" programs used to address interstate air pollution. Installation of acid gas scrubbers and other emission control devices enabled further reductions at existing plants as well as demonstrated the effectiveness of this technology at other facilities.

As a consequence of this success, future opportunities for the acid rain program generally do not exist in developing additional measures to reduce SO_2 and NOx emissions from EGUs as part of an expanded program under Title IV.[243] And, as noted above, these emissions are now primarily addressed through interstate transport programs and state implementation plans. But there is the opportunity to more clearly discern what additional "lessons" can be learned from the program to aid in the development of future legislative and regulatory programs.

Recommendations

1. The Level of Precision in Title IV Should Be Emulated in Implementing other Parts of the Clean Air Act and With Regard to Framing Future Programs

Title IV contains specific quantified levels of emission reductions (Phase 1 and Phase 2 emission caps), provides detailed instructions to EPA with regard to how emission allowances should be allocated and requires robust monitoring and reporting programs. These elements of the title both increased transparency and eased the compliance burden on the Agency and regulated entities. At a high level, then, implementation of Title IV can be contrasted with other provisions of the Clean Air Act which have sometimes been mired in delay and uncertainty. For example, efforts to regulate greenhouse emissions

from EGUs under Section 111 of the Act date back 10 years, with considerable questions remaining as to what may be considered a supportable "standard of performance." Specificity in emission requirements must certainly be backed up by technical and economic feasibility, but can serve to ensure that overall emission goals are met. To the extent permissible, EPA should strive to include such precision and clarity in the implementation of other CAA programs.

2. EPA Should Establish a CAAAC Workgroup to Further Examine Relevant CAA Issues

CAAAC recognizes that it is charged with advising EPA and not Congress. But it is also clear from our analysis that some provisions of the CAA have worked better than others. With respect to Title IV of the CAA, the precise drafting and reasonable timeframes for implementation allowed EPA to fully implement the acid rain program with a minimum of delay and exceed the emission reductions required. Consistent with the overall perspectives expressed elsewhere in this report, EPA should establish a workgroup to examine the "lessons learned" from the Title IV program and their relevance with respect to the implementation of other CAA programs and the extent to which adequate authority may or may not exist.
1.3 Support Science that Serves a Vital Role in Continued Progress on Acid Rain

3. EPA Should Support Science that Serves Vital Rule in Continued Progress Regarding Acid Deposition

NAPAP, authorized prior to the enactment of Title IV, issued an interim assessment report regarding acidic deposition in 1987 and a follow-on report in 1990. In 2011, NAPAP completed an integrated assessment of the acid rain program. Thus, the mechanisms of acidification were studied both prior to implementation of the acid rain program and the results were reviewed afterwards by NAPAP and periodic reports issued by EPA.

Since this this report was finalized, EPA's scientific efforts related to acid rain have shifted to its reviews of secondary National Ambient Air Quality Standards (NAAQS) for NO_X, SO_X from 2005-2012 and its current review of the secondary NAAQS for NO_X, SO_X, and PM initiated in 2013. Continued support of this science is important to enable continued progress in this area.

This preliminary and ongoing analysis of Title IV was key to structuring program elements and monitoring the progress achieved, as well as defining remaining challenges, *e.g.*, NOx deposition. EPA should consider this model of program development and assessment for other Clean Air Act regulations. While periodic assessments of the Clean Air Act have been completed for other programs and while EPA does, on its own initiative, examine program effectiveness, a more systematic approach may achieve better long-term results. In general, constructing explicit ties between the available science – and resulting policy goals and regulatory requirements as well as measuring quantifiable outcomes is intrinsic to longer term success.

4. EPA Should Further Assess What Elements of the Acid Rain Program Were Not Needed

Title IV of the CAA provided for allowance "set asides" and an auction of allowances. Set-asides were designed to compensate certain entities thought to be disadvantaged by general allowance formulas

contained in the title. Allowance auctions were intended to provide for additional liquidity (apart from the ability to hold and trade allowances) and these auctions were originally administered by the Chicago Board of Trade and later by EPA.

It would be instructive for EPA to retroactively assess these elements of the acid rain program, their intended policy purposes and evaluate the extent to which such policy goals were achieved or not. This review would not be designed with regard to adjusting the acid rain program, but rather should have a prospective focus as to allowance allocation, set-aside and auction programs that might be considered in the future.

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[228] https://www.epa.gov/sciencematters/legacy-epas-acid-rain-research.
[229] Pub.L. 96-294, Title VII.
[230] 42 U.S.C. §7651c(e), Table A.
[231] *Id.* §7651d.
[232] *Id.* §7651f.
[233] *Id.* §7651b(f).
[234] *Id.*
[235] Reports in later years also detailed implementation of other rules targeted at the same air pollutants implemented through interstate air pollution programs like the NOx SIP Call, the Clean Air Implementation Rule and the Cross-State Air Pollution Rule.
[236] 1995 Compliance Results, Acid Rain Program, July 1996.
[237] Acid Rain Program: Annual Progress Report, 2000 at 5.
[238] 2010 Progress Report Emission, Compliance and Market Analysis at 5.
[239] Power Sector Programs Progress Report, 2019 at 22.
[240] *Id.* at 70-99.
[241] Chart from "*The SO2 Allowance-Trading System and the Clean Air Act Amendments of 1990: Reflections on 20 Years of Policy Innovation*," National Tax Journal, June 2012, 65(2) at 425.
[242] "By 2012, allowances cleared at auction prices less than $1 per ton, well below the $1,000 per ton allowance prices of the mid-2000s. The crash in the allowance prices reflected the overlapping of new regulations—initially the Clean Air Interstate Rule, followed by the Cross-State Air Pollution Rule—that cover the same pollutant and emission sources as the SO2 cap-and-trade program coupled with the absence of any discretion delegated to EPA under the CAA to adjust the SO2 emissions cap." Looking Back at Fifty Years of the Clean Air Act, Resources for the Future, Report 20-01, October 2020 at 12.
[243] Such a program would necessarily need to be legislated.

Stratospheric Ozone Protection

Overview

Based on scientific studies by Drs. Sherwood Rowland and Mario Molina and other researchers during the 1970s, it was first theorized and then determined that chlorofluorocarbons ("CFCs") used in refrigeration, aerosol sprays and other uses could react with other gasses to destroy ozone in the stratosphere. Subsequent measurement of the earth's stratospheric ozone layer by the National Aeronautics and Space Administration confirmed that due to meteorological conditions an ozone "hole" forms over Antarctica during the winter months and the stratospheric ozone layer also declines at other latitudes, increasing ultraviolet radiation reaching the earth's surface. The stratospheric ozone layer serves to protect life on Earth from harmful ultraviolet radiation, which can result in a range of health effects, including skin cancer, eye damage and immune system suppression.

The 1977 Clean Air Act Amendments contained several purposes and findings related to ozone protection, required a study of "all substances, practices, processes and activities which may affect the stratosphere, especially ozone in the stratosphere,"[244] required a report to Congress and indicated that President should seek to negotiate international agreements aimed at developing standards and regulations.[245] The 1977 Amendments also conveyed authority for EPA, upon certain findings, to promulgate regulations for the control of substances, practices, processes or activities related to effects on the stratosphere.[246]

On March 14, 1988, the U.S. Senate provided its advice and consent to the Montreal Protocol on Substances that Deplete the Ozone Layer ("Montreal Protocol") and the United States formally ratified the Montreal Protocol on April 5, 1988. Congress subsequently approved implementing legislation for the Montreal Protocol as part of the Clean Air Act in 1990. Title VI of the Clean Air Act provided for the phaseout of class I ozone depleting substances ("ODS") which consisted of CFCs, halons, carbon tetrachloride and methyl chloroform in most cases by 2000 (these dates were later advanced by rulemaking). Substances with lesser ozone depletion potential ("ODP"), known as class II substances, consisting of hydrochlorofluorocarbons ("HCFCs") were scheduled for a later phaseout in 2015, except for certain identified uses. Other provisions provided for the phaseout of nonessential products containing ODS and for the approval of substitutes to replace class I and class II substances.[247] The interaction between the Montreal Protocol and the CAA was also made manifest in CAA section 614 which provided that Title VI was to be "construed, interpreted and applied as a supplement to the terms and conditions of the Montreal Protocol [and in] the case of conflict . . . the more stringent provision shall govern."[248]

Successes

After enactment of Title VI, EPA promulgated multiple rules to provide for the framework of phasing out ODS under the Clean Air Act (40 C.F.R. Part 82) and for implementing subsequent amendments to the Protocol ratified by the United States[249] as well as decisions of the Parties to the Montreal Protocol regarding allowable exemptions and other matters.[250] Apart from the Montreal Protocol, EPA also addressed requirements specified by Title VI, such as those applying to servicing of motor vehicle air conditioners and national recycling and emission reduction programs. EPA also promulgated 23 rules

and issued 36 notices of acceptability related to safe substitutes for ODS which effectively allowed for an earlier transition from ODS to lower or non-ODS substances.

In 2007, EPA issued a high-level report on the status of Title VI implementation. In general, the report indicated that statutory deadlines have been met or compliance was achieved ahead of the statutory schedule. In addition, the report noted that phaseout of ODS has produced a substantial "co-benefit" in terms of GHG reductions since many ODS also have high global warming potential values. These impacts in 2007 were measured at 8,900 million metric tons carbon dioxide equivalent (MMTCe), or as indicated in the report, the equivalent of reducing carbon dioxide by an amount equal the emissions associated with total U.S. residential electricity use over 13 years.[251]

Table 4. U.S. Production of First-Generation Ozone-Depleting Substances Phased Out on Schedule

Chemical Group	Production Phase Out Dates	Deadline Met
Halons	January 1, 1994	✓
Chlorofluorocarbons (CFCs)	January 1, 1996	✓
Carbon tetrachloride	January 1, 1996	✓
Hydrobromofluorocarbons (HBFCs)	January 1, 1996	✓
Methyl chloroform	January 1, 1996	✓
Chlorobromomethane	August 18, 2003	✓
Methyl bromide	January 1, 2005	✓

Table 5. U.S. Production of Second-Generation Ozone-Depleting Substances Phaseout on Schedule

Chemical Group	Production Phaseout Dates	Deadline Met
Hydrochlorofluorocarbons (HCFCs)	Cut production 35 percent by January 1, 2004	✓ (One year ahead of schedule)
	Cut production 65 percent by January 1, 2010 Cut production 90 percent by January 1, 2015 Cut production 99.5 percent by January 1, 2020 Complete phaseout by January 1, 2030	On track to meet all future requirements

It is also important to recognize that implementation of Title VI, in conjunction with the Montreal Protocol has resulted in a substantial reduction in greenhouse gas emissions. For example, CFC-12, a chemical used in most refrigeration and vehicle air conditioning systems until the early 1990s, was subject to a 100% production and consumption phaseout in 1996. CFC-12 has a GWP of 10,900 and thus phaseout of this chemical in the United States and other countries, in of itself, produced a significant reduction in GHG emissions. Similarly, HCFC-22, another commonly used refrigerant and propellant is now almost completely phased out in the United States (along with its GWP of 1,790). In 2019, it was estimated that as much as 1.1° Celsius in warming has been avoided over Artic regions through implementation of the Montreal Protocol.[252]

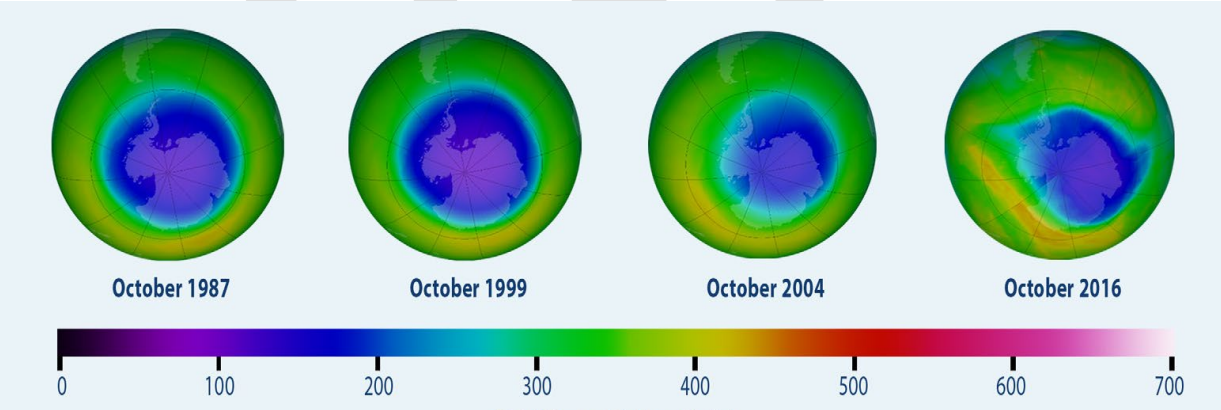
It is also generally recognized that implementation of Title VI has been a major factor in moving international markets away from class I and class II substances and in promoting a transition to safer

substitutes within the United States and other countries. A recent 2018 international assessments[253] confirms this environmental progress:

Actions taken under the Montreal Protocol have led to decreases in the atmospheric abundance of controlled ozone-depleting substances (ODSs) and the start of the recovery of stratospheric ozone. The atmospheric abundances of both total tropospheric chlorine and total tropospheric bromine from long-lived ODSs controlled under the Montreal Protocol have continued to decline since the 2014 Assessment. The weight of evidence suggests that the decline in ODSs made a substantial contribution to the following observed ozone trends:

- The Antarctic ozone hole is recovering, while continuing to occur every year. As a result of the Montreal Protocol much more severe ozone depletion in the polar regions has been avoided.
- Outside the polar regions, upper stratospheric ozone has increased by 1–3% per decade since 2000.
- No significant trend has been detected in global (60°S–60°N) total column ozone over the 1997–2016 period with average values in the years since the last Assessment remaining roughly 2% below the 1964–1980 average.
- Ozone layer changes in the latter half of this century will be complex, with projected increases and decreases in different regions. Northern Hemisphere mid-latitude total column ozone is expected to return to 1980 abundances in the 2030s and Southern Hemisphere mid-latitude ozone to return around mid-century. The Antarctic ozone hole is expected to gradually close, with springtime total column ozone returning to 1980 values in the 2060s.

Figure 12. Total Ozone (Dobson Units)



Future Challenges and Opportunities

1. Implementation of remaining phaseout schedules

While the EPA moved to end use of CFCs, halons, and other major class I ODS in the mid-1990s, a 100% phaseout level for all class I substances was not fully implemented until 2005 when this phaseout level applied to methyl bromide.[254] Certain exempted uses for methyl bromide and other class I substances remain (*e.g.*, laboratory and analytical uses[255]) but on the whole, the phaseout of class I substances is largely complete. With regard to class II substances, limitations on HCFCs began to apply in 2004;

currently the United States has implemented a 99.5% reduction in HCFC production and consumption relative to baseline levels. In 2030, no production or importation of HCFCs will be allowed. Since regulatory mechanisms, providing for production and consumption allowances are in place for the remaining periods of time, it would appear that there should be little issue with implementing the remaining phaseouts in the United States.

This, however, does not mean that Title VI has been displaced by other CAA programs (such as the case with Title IV) or that there are no remaining challenges in securing continuing phaseout of ODS. Specifically, the Montreal Protocol imposes parallel but differentiated responsibilities. Developing "Article 5" countries generally have 10 additional years to comply with the phaseout requirements that apply in the United States and other "Article 2" countries. Production of chemicals that may not be produced in the United States can continue in other countries, albeit volumes are restricted on the basis of prior production and consumption baselines.

In past years, continued production activity and the international market for ODS has resulted in illegal imports into the United States, with enforcement actions taken against a range of activities, including use of counterfeit trademarks on cannisters and importation of equipment containing ODS already phased out in the United States.[256] As the United States continues to transition away from ODS and move toward environmentally preferable substitutes, challenges may arise in terms of the need for continued enforcement and avoiding circumvention of Montreal Protocol requirements.

2. Implementation of Significant New Alternatives Policy Program

As noted above, the CAA provides authority for the Agency to approve substitutes for existing ODS. While litigation in the D.C. Circuit has affected implementation of the Significant New Alternatives Policy (SNAP) Program,[257] the Agency has continued exercise its authority under CAA section 612 and to list new substitutes.[258] Since this program also provides that current substances may be found to be "unacceptable" and thus unable to be produced after a specified date, continued implementation of the SNAP program can aid in the transition away from both higher ODS and higher GWP substances.

3. Enforcement

The transition away from class I and class II ODS occurred not only in the United States, but internationally, subject to different implementation timelines for countries classified as Article 5 "developing countries" under the Montreal Protocol. In addition, ODS may be shipped in both bulk containers and contained in products, meaning that enforcement of EPA Title V regulations can take many forms. EPA continues to take multiple enforcement actions each year, many of which result in settlement.[259] Compliance in other countries is subject to processes of the Montreal Protocol.

4. Addressing HFCs

HFCs were utilized as substitutes for class I and class II substances, either directly or in blends, due to their relatively low ozone depletion potential ("ODP"). Recognizing that HFCs can have relatively high GWP values, in late 2020, following litigation in the D.C. Circuit affecting EPA's available authority under the SNAP program,[260] Congress approved the American Innovation and Manufacturing Act ("AIM Act") to provide authority for EPA to phasedown HFC production and consumption in the United States on a

similar timeframe to the Kigali Amendment to the Montreal Protocol, which provides for the phasedown of HFCs under the Montreal Protocol.

The AIM Act, however, is not an amendment to the CAA, but stand-alone legislation although its provisions parallel the structure of Title VI. The AIM Act requires EPA to finalize implementing regulations by the fall of 2021.[261] The Kigali Amendment, at present not ratified by the United States, is projected to reduce future climate change due to HFCs, with projected reductions in temperature of from 0.2 to 0.4 Celsius.[262]

Recommendations

1. EPA should conduct a formal "lessons learned" exercise from implementation of Title VI of the CAA utilizing an allowance-based system.

Unlike Title IV of the CAA, Title VI of the CAA does not contain detailed statutory language regarding allocation of emission allowances. CAA section 604 provides that EPA is to promulgate regulations to phase out the production and consumption of class I substances in accordance with the phaseout schedule contained in the section and other provisions of the title, subject to provided exceptions. Regulatory authority with regard to class II substances is similarly phrased (CAA section 605(c)). CAA section 607 required rules for the issuance of allowances for production and consumption of class I and class II substances and for the transfer of allowances. Trading with other Parties to the Montreal Protocol was conditionally allowed in CAA section 616.

EPA promulgated class I and class II regulations on the basis of an allowance system it developed under prior CAA authority it used to implement the 1987 Montreal Protocol.[263] In a 1991 proposed rule to implement new authority conveyed by the 1990 Amendments, EPA cited but did not extensively discuss its authorities under Title VI of the CAA for an allowance system, indeed noting that CAA section 604(a) limits on production were self-executing.[264] In the years after the first allowance regulations were promulgated pursuant to the 1990 Clean Air Act Amendment, EPA has promulgated additional allowance allocations and rules to transition away from ODS.

After almost 30 years of regulatory effort, EPA should comprehensively review how the phaseout of class I and class II substances was successfully managed, what could have been managed better, the extent of trading and transfer of allowances, the extent and effects of exemptions allowed, market-based systems that formed in response to EPA rules, the efficacy of public/private partnerships and the extent to which effective substitutes were created in response to these systems. As noted above, EPA has produced high level reports noting the progress and achievements of the stratospheric ozone protection program, but CAAAC is unaware of more granular analysis of the title VI regulatory system that led to such gains.

2. EPA should define how implementation of Title VI programs affecting HFCs will interact with implementation of the AIM Act.

EPA has approved various substitutes under the SNAP program, including substitutes that affect the use of HFCs. As noted above, the extent to which EPA may utilize the SNAP program to address HFCs has been affected by litigation.[265] Passage of the AIM Act grants EPA new authority to address HFCs, but the Agency has not indicated how authority under Title VI will either be affected, or not affected, by new authority in

the AIM Act that is outside of the CAA. EPA should clarify how it will administer two concurrent authorities, particularly with regard to how such authorities will be utilized or not utilized to address GHG emissions.

3. EPA should articulate how Title VI programs and other CAA authorities addressing GHGs interact.

Individual GHGs may have widely divergent impacts on stratospheric ozone. Some model simulations indicate both positive and negative effects. For example, increasing amounts of carbon dioxide (CO_2) results in lower temperatures throughout the stratosphere "slowing down the rate of most destruction reactions."[266] Increases in methane lead "to changes in stratospheric chemistry that augment the increase in ozone driven by stratospheric cooling."[267] On the other hand an increase in nitrous oxide (N_2O) results in "significant decreases in global ozone due to chemical effects."[268] Past implementation of the Title VI is now recognized to have resulted in increases in HFCs with relatively high GWP; these gases are now the focus of reduction through the AIM Act. Given possible positive and negative effects, EPA needs to examine how such findings could or should affect its implementation of Title VI in conjunction with other CAA authorities. EPA should review both near-term and longer-term objectives and how any positive and negative consequences can be managed under available authority.

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[244] 42 U.S.C. §7453 (1977).
[245] *Id.* §7456.
[246] *Id.* §7457.
[247] See generally 42 U.S.C. §§7671i, 7671k.
[248] *Id.* §7671m(b).
[249] The London Amendment (June, 1990); the Copenhagen Amendment (November 1992); the Montreal Amendment (September 1997); the Beijing Amendment (December 1999).
[250] For example, exemptions allowing for the continued production of methyl bromide (used as an agricultural fumigant) or CFCs used in metered-dose inhalers for treatment of asthma and other lung conditions were subject to a review process by technical committees of the Montreal Protocol and subsequent decisions to approve specific quantities.
[251] Achievements in Stratospheric Ozone Protection, Progress Report, April 2007.
[252] Reduction in surface climate change achieved by the 1987 Montreal Protocol, R. Goyal, M. England, A. Gupta and M. Jucker, Environmental Research Letters, Vol. 14, No. 12 (Dec. 2019).
[253] Scientific Assessment of Ozone Depletion: 2018, World Meteorological Organization Global Ozone Research and Monitoring Project – Report No. 58, January 2019.
[254] 42 U.S.C. §7671c(h).
[255] 80 Fed. Reg. 3,885 (Jan. 26, 2015).
[256] https://www.epa.gov/ozone-layer-protection/enforcement-actions-under-title-vi-clean-air-act#2020.
[257] *Mexichem Fluor v. EPA*, 866 F.3d 451 (D.C. Cir. 2017), *Mexichem Fluor v. EPA*, No. 17-1024 (D.C. Cir. 2019).
[258] *See, e.g.*, 86 Fed. Reg. 24,444 (May 6, 2021).
[259] https://www.epa.gov/ozone-layer-protection/enforcement-actions-under-title-vi-clean-air-act#2020.
[260] *See* nt. 13, *supra.*
[261] 86 Fed. Reg. 27, 150 (May 19, 2021).
[262] https://www.fluorocarbons.org/environment/climate-change/kigali-amendment/
[263] See 57 Fed. Reg. 33,765 (July 30, 1992). EPA also issued temporary regulations pursuant to CAA section 604 for 1991. 56 Fed. Reg. 9,518 (Mar. 6. 1991).
[264] 56 Fed. Reg. 49,552 (Sept. 30, 1991).
[265] *See* nt. 13, *supra.*
[266] Twenty Questions and Answers About the Ozone Layer: 2018 Update, NOAA Chemical Sciences Laboratory at Q20.

[267] *Id.*
[268] *Id.*

Voluntary Programs

Introduction

While much of the Clean Air Act is focused on state and federal regulation of air pollution, voluntary programs and initiatives have been important in supporting the overarching goal of pollution prevention. There have been dozens of such programs over the past 50 years and cataloging all of these programs is beyond the scope of this report. However, the CAAAC wishes to highlight some of programs we felt were especially noteworthy and identify some general challenges, opportunities, and recommendations related to voluntary air quality programs generally.

Accomplishments

1. **Small Business Compliance Assistance Programs**: Section 507 of the 1990 Clean Air Act (CAA) amendments required each state to establish a Small Business Environmental Assistance Program (SBEAP) to help small business comply with the Clean Air Act. While large firms have the resources and expertise to hire professional staff and consultants dedicated solely to compliance with air quality regulations, small firms that may be subject to Clean Air Act regulations may lack the needed resources and expertise. The SBEAP provides a crucial avenue for small business to receive help from professional staff to achieve compliance with the applicable regulations, which has helped the public benefit from emission reductions implemented by small businesses and the small businesses in ensuring that they do not find themselves out of compliance with rules and subject to enforcement from state or federal authorities.

2. **Voluntary Programs to Attain the National Ambient Air Quality Standards (NAAQS)**: Since 1997, EPA has issued a series of guidance documents that have encouraged the implementation of voluntary programs as part of State Implementation Plans (SIP) revisions for the attainment of the NAAQS. These programs have significantly expanded the opportunity for States, Local Governments, and Tribes to incorporate these types of initiatives into their SIPs in lieu of more traditional point source emission controls on which NAAQS-related SIP revisions typically rely. These have included:

    2.1. Guidance on Incorporating Voluntary Mobile Source Emission Reduction Programs in State Implementation Plans (SIPs) (1997) – allowed up to 3% of required emission reductions needed to demonstrate attainment of NAAQS or reasonable further progress (RFP) in reducing emissions to be from voluntary mobile source programs such as commuter programs, special event management, vehicle use limitations/restrictions, idling reduction, and small engine and recreational vehicle programs.

    2.2. Improving Air Quality with Economic Incentives (2001) – This guidance enabled California and Texas to incorporate programs to replace older heavy-duty diesel vehicles and off-road equipment with newer, cleaner vehicles and equipment, thereby accelerating the benefits of EPA's mobile source emissions standards, as well as state-level or local/regional credit-trading programs.

    2.3. Incorporating Voluntary Stationary Source Emission Reduction Programs into SIPs (2001) – Similar to the guidance on credits for voluntary mobile source programs, this guidance allows

for up to 3% of required emission reductions for an attainment or RFP SIP to be met using voluntary stationary source emission reductions beyond what is required for meeting RACT, BACT, or LAER emission limits.

2.4. Guidance on SIP Credits for Emission Reductions from Electric Sector Energy efficiency and Renewable Energy Measures (2004) – This guidance document built on the 2001 *Incorporating Voluntary Stationary Source Emission Reduction Programs into SIPs* guidance document by identifying measures that could be incorporated into a SIP to meet attainment demonstration or RFP credit requirements. These included demand-side reductions like replacement of older appliances with Energy Star appliances, and enhancing energy efficiency in buildings through better insulation, etc., as well as supply-side strategies that could increase the efficiency of existing generating assets (such as combined heat and power) or building solar or wind power.

2.5. Incorporating Emerging and Voluntary Measures in a State Implementation Plan (SIP) (2004) – This guidance provided for a mechanism for EPA to grant "provisional" emission reduction credits for emerging measures (measures that do not have the same high degree of certainty for quantification purposes), and voluntary measures, which are not enforceable against a particular source. EPA stated in this document, "In light of the increasing incremental cost associated with stationary source emission reductions and the difficulty of identifying additional stationary sources of emission reduction, EPA believes that it needs to encourage innovative approaches to generating emission reductions." This quote highlights the value that such measures can provide to air quality planning efforts.

2.6. Guidance on Incorporating Bundled Measures in a State Implementation Plan (2005). EPA issued this guidance in 2005 to address situations in which States, Tribes, and Local Governments may have not included measures in a SIP due to uncertainties as to the exact impact from each individual measure, but which – in aggregate – are believed to be achieving significant emission reductions.

3. **Voluntary Programs to Maintain Attainment with the NAAQS**: These programs were designed by EPA in order to help areas designated "attainment/maintenance" for the O_3 NAAQS and more recently, the $PM_{2.5}$ NAAQS attain and/or maintain the NAAQS. Since the Clean Air Act is not very specific about the timing or requirements for designating an area as "nonattainment" following the initial round of area designations, one of the main reasons these programs were created was to provide a framework for bringing any area designated "attainment/unclassifiable" that were experiencing violations of the NAAQS into attainment as quickly as possible without needing to resort to a nonattainment designation. Aside from the air quality benefits of attaining and maintaining the NAAQS, avoiding a nonattainment designation for these areas also relieved EPA, states, and local areas from the many regulatory burdens that are triggered by a nonattainment designation.

3.1. Flexible Attainment Region (FAR, 1995-2001): First developed in Tulsa, Oklahoma, the FAR program involved an agreement between local officials, states, and EPA to develop and implement a SIP revision to bring areas into attainment of the 1979 O_3 NAAQS that had been violating it but had not yet been designated nonattainment.

3.2. **One-Hour O_3 Flex Program (1-hr O_3 Flex: 2001-2002)**: This voluntary program did not involve SIP revisions but, rather, was designed to help ensure that areas that were measuring

exceedances of the 1979 1-hour O_3 NAAQS were able to attain or maintain compliance with the NAAQS. This program included community-driven development of a voluntary air quality plan for the region. Five of the six areas participating in the program (Austin, Corpus Christi, Little Rock, Shreveport-Bossier City, Tulsa, and Quad Cities Metro Area) were located in EPA Region 6, which pioneered much of the structure of these voluntary planning efforts.

3.3. **Early Action Compact (EAC, 2002 – 2004)**: The EAC program was rather unique among all of EPA's voluntary air quality planning efforts since the 1990 Clean Air Act Amendments in that it provided tangible regulatory relief in the form of a multi-year deferral of an area's designation for the 1997 8-hour O_3 NAAQS in 2004 in exchange for a SIP revision that would demonstrate attainment of the NAAQS by 2007 and continued maintenance of the NAAQS through 2015. The measures included in the SIP revisions could include a combination of voluntarily adopted regulatory measures, such as expanding the geographic coverage of state rules that apply to nonattainment areas to these "near-nonattainment areas," and voluntary measures such as expanded travel demand management (TDM) and energy efficiency/renewable energy measures. This program resulted in SIP revisions for many areas across the country with measures that remain in place today. The program was a product of the unique circumstances around the 1997 8-Hour O_3 NAAQS, including extended litigation that went to the Supreme Court in 2001, and EPA's proposal for implementing the NAAQS following the completion of the litigation. The specific regulatory relief provided by the program – a multi-year deferral of a nonattainment designation, has been determined by the courts to not be permissible under the Clean Air Act. However, the basic structure of the program – some degree of regulatory relief from a nonattainment designation in exchange for voluntary implementation of additional emission reduction measures – remains very appealing to local communities and states considering how to handle "near-nonattainment" situations.

3.4. **8-Hour O_3 Flex Program (8-hr O_3 Flex, 2006 – 2012)**: The 8-Hr. O_3 Flex program provided a structure for continued voluntary O3 planning in near-nonattainment areas. Key provisions included periodic reporting to EPA on the status of the region's efforts, and a promise by EPA to ensure that SIP credit was assigned for any measures documented in the 8-Hr. O_3 Flex Program.

3.5. **Advance Program (2012-current)**: The Ozone Advance Program was announced in 2012 as EPA's replacement for the 8-hr O_3 Flex Program; it was designed to broaden participation. Under this program, states could sign up to cover all of their attainment/unclassifiable areas, and nonattainment areas classified as "Marginal" could participate as well, since there is no requirement an actual attainment plan for such areas. EPA added a PM Advance Program in 2013 and now refers to the overall program as simply the "Advance Program." While EPA takes care not to make any commitment to provide any regulatory relief to areas participating in the Advance Program, it certainly provides a mitigating factor in favor of limiting the geographic extent of a potential initial nonattainment designation, deferring designations by a year, or – if a violation occurs after the initial designation, deferring a redesignation decision incentivizing state/local agencies to take immediate steps to ensure continued NAAQS attainment. Currently, EPA targets areas with O_3 design values of 65 ppb or higher (compared to the 70 ppb NAAQS), areas with annual $PM_{2.5}$ design values of 10 $\mu g/m^3$ or higher (compared to the 12 $\mu g/m^3$ NAAQS), and areas with 24-hour $PM_{2.5}$ 30 $\mu g/m^3$ to recruit for participation, but the program is open to all areas that are not designated "nonattainment" for all three of these NAAQS.

4. **Diesel Emission Reduction Act (DERA) and National Clean Diesel Campaign**:

4.1. The DERA program was adopted by Congress as part of the Energy Policy Act of 2005, following successful implementation of heavy-duty diesel vehicle and equipment replacement/repower/retrofit programs in California and Texas.

4.2. Congress first appropriated funds to the program in Fiscal Year (FY) 2008, and the American Recovery and Reinvestment Act (ARRA) of 2009 provided additional funding for the program that year. Congress re-authorized the program in 2010 and 2020 at $100 million per year. The program is up for re-authorization again in 2024.

4.3. While the DERA statutory provisions reside outside of the Clean Air Act, they rely on EPA-certified engines and technologies and DERA administered by EPA with the purpose of helping improve air quality. EPA has incorporated other attributes of the Clean Air Act in the program design as well, such as giving priority to nonattainment areas, areas with a high degree of exposure to diesel particulate matter, and areas participating in voluntary air quality programs design to maintain compliance with the NAAQS.

5. Energy Star:

5.1. ENERGY STAR is the government-backed symbol for energy efficiency, providing simple, credible, and unbiased information that consumers and businesses rely on to make well-informed decisions. Thousands of industrial, commercial, utility, state, and local organizations partner with EPA to deliver cost-saving energy efficiency solutions that protect the climate while improving air quality and protecting public health. Since 1992, ENERGY STAR and its partners have helped American families and businesses save 5 trillion kilowatt-hours of electricity, avoid more than $450 billion in energy costs, and achieve 4 billion metric tons of greenhouse gas reductions. Over the lifetime of the program, every dollar EPA has spent on ENERGY STAR resulted in $350 in energy cost savings for American business and households. In 2019 alone, ENERGY STAR and its partners helped Americans save nearly 500 billion kilowatt-hours of electricity and avoid $39 billion in energy costs.

6. SmartWay:

6.1. EPA's SmartWay program helps companies advance supply chain sustainability by measuring, benchmarking, and improving freight transportation efficiency. Launched in 2004, this voluntary public-private program:

6.1.1. provides a comprehensive and well-recognized system for tracking, documenting and sharing information about fuel use and freight emissions across supply chains.

6.1.2. helps companies identify and select more efficient freight carriers, transport modes, equipment, and operational strategies to improve supply chain sustainability and lower costs from goods movement.

6.1.3. supports global energy security and offsets environmental risk for companies and countries.

6.1.4. reduces freight transportation-related emissions by accelerating the use of advanced fuel-saving technologies.

6.1.5. is supported by major transportation industry associations, environmental groups, state and local governments, international agencies, and the corporate community.

Challenges

1. **Small businesses still face significant burdens in navigating the multitude of regulatory requirements in the Clean Air Act**. These are in addition to the numerous other regulatory requirements they face over a wide range of issues.

2. **Large numbers of areas initially designated as "Moderate" for O_3 limits utility of SIP guidance on voluntary measures.** Around 80% of areas that have been designated nonattainment for the 1997, 2008, and 2015 O_3 NAAQS are classified as "moderate," which means they do not require attainment plans. This means that these tools measures are not as useful for the vast majority of O_3 nonattainment areas. Furthermore, the limited time between a "Marginal" area failing to meet its attainment date and the due date for the attainment demonstration under its new classification means that there is not enough time to implement the voluntary measures.

3. **There is a lack of certain and tangible regulatory relief for participation in voluntary programs.** The current structure of voluntary attainment/maintenance programs does not provide tangible regulatory relief in exchange for the voluntary steps that EPA is encouraging these areas to take. The lack of this type of relief may significantly diminish the amount of emission reductions that states, and communities might otherwise be willing to take if they had firmer commitments from EPA.

4. **There is a lack of clarity on "out-of-cycle" designations.** As discussed in the "NAAQS attainment and maintenance" section of this report, one issue that communities face is the lack of clarity under what circumstances EPA might proceed with an "out-of-cycle" nonattainment designation, since such situations have been so rare to date. The lack of clarity on this point can sometimes result in a "boy crying wolf" effect when local air quality programs in near-nonattainment areas try to work with local stakeholders to participate in planning efforts – many may not believe that an "out-of-cycle" nonattainment designation is a very real possibility, which diminishes the likelihood of achieving implementation of additional measures early on.

5. **Not all voluntary plans or programs are equally rigorous.** One concern that has been raised on occasion about voluntary programs is that in some cases, agencies may only memorialize their existing measures rather than implementing new ones. For voluntary planning efforts that are rigorous, the wide degree of variation in the quality of participation across the country may inhibit the ability of some areas to receive more consideration for their own efforts in EPA decision-making related to area designations, among other issues.

6. **Statutory provisions discourage early reductions**: For some regulatory requirements that apply to nonattainment areas, such as nonattainment NSR and the 15% RFP requirement for VOC emissions, there are ways that current rules, guidance, and practice can inadvertently penalize such areas by creating stricter baselines for the areas from which percent reduction requirements would then be calculated if designated nonattainment in the future.

Opportunities

1. As the "low-hanging fruit" for reducing emissions from stationary sources through rulemaking and from mobile sources through emissions standards become less and less available moving forward, voluntary planning efforts may become an increasingly important tool for attaining and maintaining the O_3 and PM NAAQS, especially if they are tightened further in the future.
2. Thirty years of institutional experience under the 1990 Clean Air Act Amendments has enabled EPA, states, and local governments to better understand the desirability of avoiding a nonattainment designation to begin with rather than fixing it after the fact, and that provides a powerful motivation to take further action.
3. EPA modeling indicates that all Class I areas are projected to see improvements in visibility this decade. These improvements are likely mostly driven by mobile source emissions standards, implementation of the O_3 and $PM_{2.5}$ NAAQS, new source performance standards, and new source review permitting, providing a good baseline of improvements that would be expected to occur even without additional BART rules.[269]

Recommendations

1. **Transport SIP Credits for Voluntary Measures**: EPA should consider updating its guidance regarding SIP credits to enable voluntary measures to count towards any obligation a state may have to abate its downwind impact on another state. Since the emission reductions could come from anywhere within the state, this could provide a comprehensive mechanism for encouraging and tracking voluntary measures nationwide in all areas, regardless of designation.
2. **Expand Opportunities for Attainment and RFP SIP Credits from Voluntary Measures**: It has been a long time since EPA has re-evaluated the guidance issued between 1996 and 2005 on voluntary measures and a re-evaluation is due, particularly with an eye towards expanding the opportunities to encourage additional voluntary emission reductions. This may include items such as:
    2.1. Increasing the maximum limit on creditability of voluntary measures;
    2.2. Adjusting emission baselines for NSR permitting and 15% RFP VOC requirements;
    2.3. Encouraging voluntary adoption of measures on a "contingency" basis that would be triggered by a nonattainment designation or a bump-up from Marginal to Moderate status. Since EPA cannot require either of these, it could at least provide something like "pre-clearance" and approval of these on a contingency basis to enable the acceleration of emission reduction measure implementation in such areas.
3. **Provide Tangible Benefits to Areas Voluntarily Reducing Emissions**: While the specific benefit provided in the EAC program may not be able to be offered right now, there are many areas in which EPA does have discretion that could be offered as a tangible benefit of voluntarily reducing emissions, especially if EPA went through a formal notice and comment period for such a policy to ensure broader input and ensure a higher degree of legal durability for the policy.

3.1. **1-Year Postponements of Initial Designations**: EPA has the authority to postpone initial designations by up to 1 year beyond the default 2-year timeframe following a NAAQS designation, and it can offer this to areas that are just over the level of the NAAQS but are engaged in rigorous voluntary planning efforts with real emission reductions.

3.2. **Initial Designation as Unclassifiable**: EPA has the authority to designate areas as "unclassifiable" rather than "attainment" or "unclassifiable." While there are no formal regulatory consequences for an "unclassifiable" designation, if an area is very close to the level of the NAAQS at the time initial designations are due, and perhaps did not have data above the level of the NAAQS for all three of the years included in the averaging period, EPA could use an "unclassifiable" designation for areas engaged in voluntary planning efforts with the understanding that the situation will be reevaluated annually until the region's pollution levels are clearly going to remain in compliance with the NAAQS and could be redesignated to "nonattainment" if certain milestones are not met.

3.3. **Issue Limited Protective Notices for areas after Initial Designations**: EPA enjoys broad discretion regarding when and how to proceed with a redesignation to nonattainment after an area has initially been designated "attainment" or "unclassifiable" if it subsequently violates the NAAQS. EPA could establish a policy stating that it would provide something like a "protective finding" that would offer areas participating in voluntary planning to avoid an "out of cycle" nonattainment designation for a defined period of time if they recorded a violation within that time frame. This would more clearly establish parameters and benefits to "near-nonattainment" areas for participating in such programs, and it would provide leverage for them to seek additional emission reduction measures within their communities.

4. **Continue to Support DERA, Energy Star, and SmartWay, and Other Voluntary Programs**

4.1. **DERA**: EPA should continue to request the maximum funding authorized for DERA as part of its annual budget requests, should advise Congress on the amount of funding that would be required to fully replace older diesel vehicles and equipment over the next 5-10 years, and should consider program design enhancements that could take maximum advantage of some emissions sources and areas that would uniquely benefit from national-level funding as opposed to state or local programs. These would include: 1) sources that routinely cross state lines like long-haul trucks, locomotives, and ships; 2) tribal areas; 3) port areas; and 4) smaller states with less capacity to establish or manage their own diesel replacement grant programs.

4.2. **Energy Star, SmartWay, and Other Voluntary Programs**: EPA should continue to support Energy Star, SmartWay, and other voluntary programs to improve air quality in order to achieve cleaner air quicker and at lower cost than what may be possible through strictly regulatory programs. Where it would be useful, EPA should consider new programs and should seek the CAAAC's input to help guide the design and implementation of these programs.

[269] https://www.epa.gov/sites/production/files/2019-10/documents/updated_2028_regional_haze_modeling-tsd-2019_0.pdf

Indoor Air

Overview

Standards for ambient air quality have existed since 1970 when Congress first established the Clean Air Act (CAA). 1970 was also the year that President Nixon signed the Occupational Safety and Health Act (OSHA), establishing indoor air quality standards to protect industrial worker health and safety. Through these statutes, the US utilizes health-based regulations to protect the public from a range of airborne pollutants, and they have done so while ensuring economic growth. EPA has estimated that the CAA's benefits have outweighed its costs by a factor of thirty to one.[270] While for OSHA, there is measurable evidence that the standards have prevented injuries and illness, in turn ensuring a safe and viable workforce.[271] It should be noted that the success of both statutes is also linked to the agencies' deep commitment to *non-regulatory* measures, which include education, training, investment in technology and voluntary partnerships.

Through the CAA and OSHA, the public is protected from hazardous levels of *outdoor* air pollution and industrial workers are protected from hazardous levels of *indoor* air pollution. However comprehensive public health standards for *indoor* air quality, in residences, schools, community buildings or commercial spaces, do not yet exist at the federal level. This gap in public health and safety is not negligible: indoor air generally contains more air pollutants than outdoor air[272], and many of those pollutants occur at higher concentrations than outdoor air.[273] Activity patterns compound this exposure, as adults spend up to 87% of their time inside enclosed spaces, and another 6% of their time in enclosed vehicles.[274] Certain segments of the population (e.g., elderly, infants, chronically-ill) are indoors on a near-continuous basis.

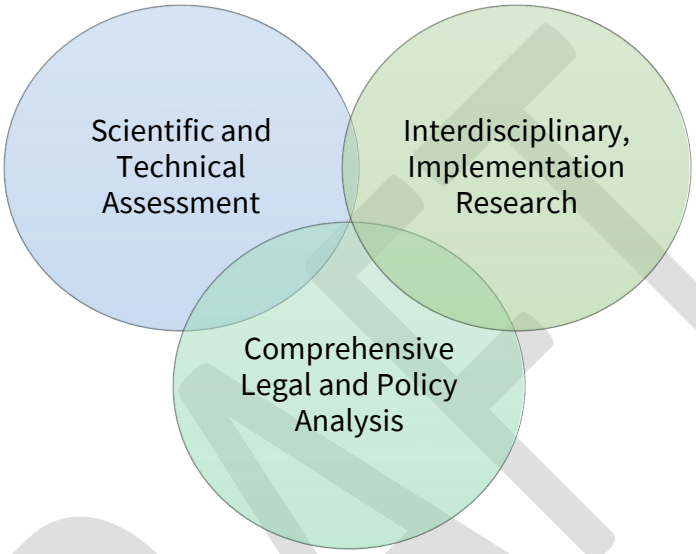
In the unregulated indoor environment, there is wide variability of pollutant species, sources, and chemical interactions. Inside most structures, the air is a mix of outdoor pollutants that have entered through infiltration or through natural and mechanical ventilation systems, coupled with pollutants emitted or generated from within the structure. This includes building materials and furnishings, human bioeffluents, a wide variety of occupant-generated pollutants from cooking, using consumer products, home improvement activities, conducting hygiene practices, smoking, etc. as well as pollutants that may be emitted from certain building materials, excess moisture, heating and cooling systems, and combustion gases from wood, natural gas, propane, oil, tobacco, and candles.[275] In addition, reactive chemical processes can also occur indoors, generating an additional source of pollutants.[276]

Through epidemiological, toxicological and exposure science research, it is well-established that these indoor air pollutants produce significant (and often inequitable) economic[277], medical[278], and public health costs[279] to society. As with the World Health Organization, European Union countries recognize indoor air pollution as an important harm, and many have adopted indoor air quality standards and legislation. As with OSHA, EU and other countries address indoor air quality regulation through a blend of source controls, engineering controls and administrative controls. This 50th Anniversary report recommends that EPA build on the success of the CAA by developing a strategy exploring the viability of the federal government establishing national *indoor* air quality guidelines and/or standards.[280]

Recommendations

1. EPA should consider a multi-pronged framework to guide their research and analysis. In Figure 13, recommended branches of research include: 1) Scientific and Technical Assessment, 2) Interdisciplinary Implementation Research, and 3) Comprehensive Legal and Policy Analysis.

Figure 13. Proposed Framework for a Multidisciplinary Analysis of U.S. Indoor Air Quality Standards



2. EPA should study the extent to which high concentrations of criteria or hazardous air pollutions outdoors lead to increased concentrations of these pollutants indoors and assess whether existing integrated science assessments and risk assessments, respectively, do or do not account for indoor air pollution exposure can be linked back to ambient air pollution levels. EPA should also seek to understand the extent to which total exposure to criteria and hazardous air pollutants occurs outdoors versus indoors and the respective source of each.
3. The agency should evaluate those methodologies and quantitative standards used by other countries who have adopted reference values, air quality limits and exposure guidelines. Many countries have established long-term and short-term exposure limits, screening values, or "Indoor Air Reference Levels" that can be regulatory, voluntary, or employed when conducting assessments.
4. The agency should review and assess the impact and potential adaption of other non-EPA federal regulatory measures on indoor air quality. For example, the Department of Energy is required to consider the impact of energy efficiency on habitability and on persons, and HUD is required to promulgate standards for the construction and safety of manufactured housing, including indoor air.
5. The agency should perform a policy analysis of state and local "clean indoor air" laws (e.g., ordinances that prohibit smoking in public spaces) to assess the results of such efforts, exploring the efficacy and impact of these laws, including issues related to enforcement and implementation.

6. The agency should consider approaches for coordinating current non-CAA EPA authority applicable to indoor environments, which are generally pollutant-specific (e.g., lead, radon, asbestos) and scattered across a variety of statutes, including TSCA, FIFRA, CERCLA, and consumer product laws.

7. The agency should continue to collaborate with ventilation and building industries, and other federal agencies (e.g., CDC, DHHS, HUD) to review standards for ventilation in residential buildings (e.g., ASHRAE Standard 62.1 and 62.2), with the aim of determining the type and concentration of indoor air pollutants and pathogens that can be removed through ventilation and filtration.

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[280] The CAAAC is not taking a position on what authority may or may not be available within the CAA to address air pollution that may be experienced indoors, nor regulatory definitions that describe "ambient air." In addition, consistent with recommendation 3, any review undertaken should assess status of existing state and local authority.

Conclusion

The Clean Air Act Advisory Committee (CAAAC) was established to "…advise the U.S. EPA on issues related to implementing the Clean Air Act Amendments of 1990". All members of the committee bring specific expertise and experience to the issues EPA addresses. This report was developed with participation as a hallmark and with the vast knowledge of the CAAAC utilized.

In developing this report, the CAA 50th Anniversary Report Committee noted participation as a goal. This mirrors the intent of the CAA. The CAAAC was consulted through successful breakout sessions during the full committee meeting. The report committee encourages increased consultative use of the CAAAC through additional participatory sessions at meetings. CAAAC members are problem solvers and want to share their vast knowledge and expertise with the goal of protecting and enhancing air quality and promoting the productive capacity of the population.

While the CAA has largely stood the test of time over its 50 years, the committee noted several areas where the CAA is simply in need of updating to be more effective with the issues and processes of the time. Due to the complexity and difficulty of legislation and the varying viewpoints on whether it is needed and its content, the recommendations in this report focus on the regulatory structure and can be carried out under the framework of the CAA. The CAAAC encourages further discussion, and perhaps a future report, to note challenges that may require additional legislation.

In summary, the CAAAC recommends the following:

1. EPA should report back to the CAAAC on these recommendations within 1 year and periodically thereafter.
2. EPA should make more extensive use of the CAAAC when important issues regarding implementation of the Clean Air Act are in the pre-proposal or comment phase in order to obtain broad and informed stakeholder input.
3. EPA should consider establishing a CAAAC workgroup to develop legislative options and recommendations for updates to the Clean Air Act that may either be needed to address challenges and opportunities identified in this report.