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The Magazine for Environmental Managers September 2018

National Ambient Air Quality Standards

As EPA Goes Back to Basics, State and Regional Agencies Strive to Continue NAAQS Successes

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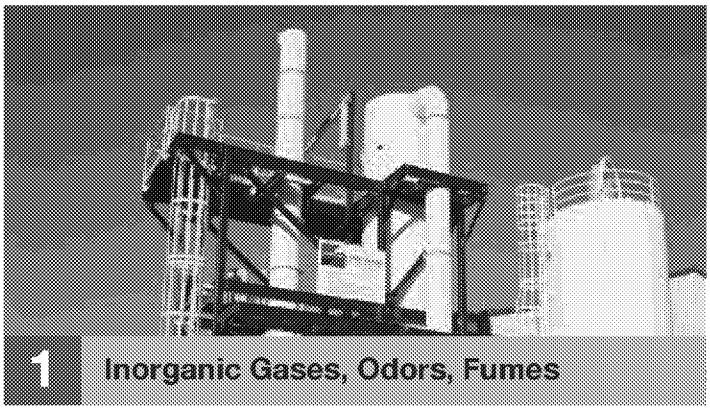

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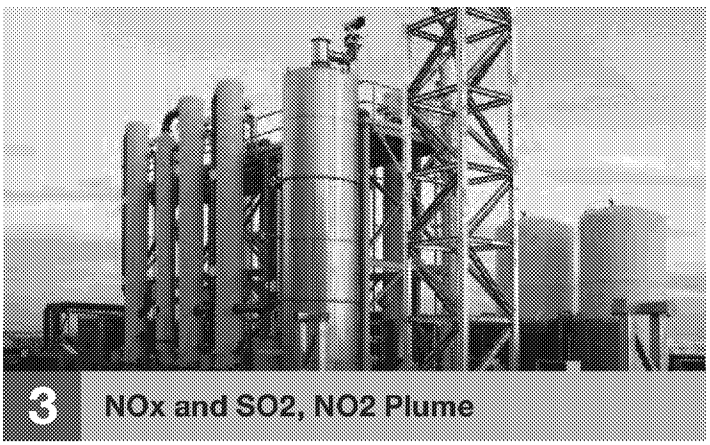

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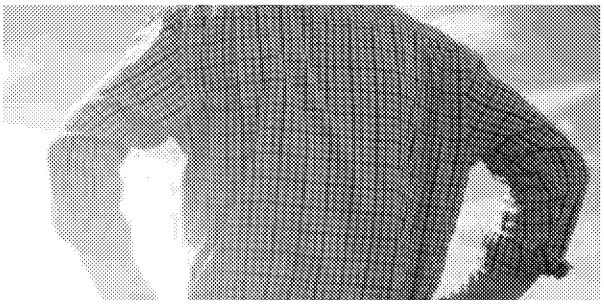
Federal and State Perspectives on National Ambient Air Quality Standards

by John Kinsman

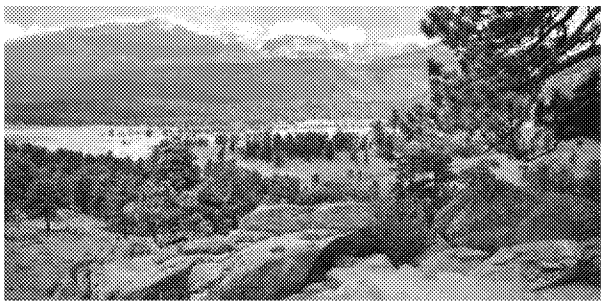
This issue of *EM* focuses on the U.S. Clean Air Act (CAA) National Ambient Air Quality Standards (NAAQS) program. Authors from the federal government (U.S. Environmental Protection Agency; EPA) and three state associations—Association of Air Pollution Control Agencies (AAPCA); National Association of Clean Air Agencies (NACAA); and Western States Air Resources Council WESTAR)/Western Regional Air Partnership (WRAP)—discuss various NAAQS science and policy topics.



EPA's 'Back-to-Basics' Process for Review of the National Ambient Air Quality Standards
by Alexander Dominguez and Clint Woods, EPA

A Story Seldom Told: National Ambient Air Quality Standards and Success in Air Pollution Control
by Jason Sloan, Stuart Spencer, and Nancy Vehr, AAPCA

For NAAQS, Follow the Science
by Miles Keogh, NACAA



Western Ozone NAAQS Implementation Issues: Addressing Background and Transport
by Mary Uhl and Tom Moore, WESTAR/WRAP

Departments

Message from the President: **Leveraging Technology to Better Serve Members**
by Chris Nelson

In Memoriam: **George R. Offen, Ph.D. (1939-2018)**

Last Stop: **Getting to Know A&WMA's Organizational Members**

Columns

PM File: **Minding Business**
by David L. Elam
This month, *PM File* reminds us to practice mindfulness and avoid the pitfalls of media multitasking.

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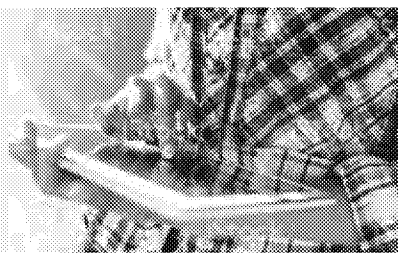

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Leveraging Technology to Better Serve Members

by Chris Nelson, P.E. » president@awma.org

This month's *EM* provides policy and technical updates related to the U.S. National Ambient Air Quality Standards (NAAQS). The ozone NAAQS typically receives the most attention, but standards for particulate matter, sulfur dioxide, and nitrogen oxides are also important for public health and can create compliance challenges during permitting or State Implementation Plan development. The U.S. Environmental Protection Agency (EPA) regularly reviews the science supporting the various NAAQS and updates them when appropriate. In practice, the updates lead to ongoing changes in both implementation guidance from regulatory agencies and compliance strategies for communities and permitted facilities. I hope this issue of *EM* provides useful information for members as you navigate NAAQS attainment issues.

Last month, I discussed mentoring, one of my long-term focus areas for our Association. This month, I want to delve into a second focus area: the use of modern media for content delivery.

A&WMA has adopted some new practices for delivering programs, including basic elements (e.g., LinkedIn groups and email news updates) and effective current practices (e.g., webinars). We have a minimal social media presence, though our Young Professionals Advisory Committee (YPAC) is active on Twitter and adds value. A key challenge is to match our capabilities with the needs of our members and customers. I have a few ideas and hope you, our members, can provide feedback and help innovate at the local level.

My kids spend a ridiculous amount of time watching YouTube videos. We can't emulate the business model of the YouTubers they follow though. I don't think A&WMA members are clamoring for videos of me adopting a silly voice and providing commentary as I navigate AP-42 or AERMOD input files. However, we could potentially cooperate with member companies or other partners to provide "how does it work?"-style videos for educational purposes. YPAC has been executing similar sessions at our Annual Conference & Exhibition for several years. In 2018, they added live demonstrations at the Young Professional Hub on the exhibit floor in Hartford. An accessible library that explains the fundamentals of stack testing or the operations of a baghouse may be useful for professional development.

While educational videos would be relatively static over time, A&WMA members are also looking for real-time updates on policy or technology changes. At our 2018 A&WMA Leadership Training Academy in April, our incoming YPAC Chair, Paul Algu, asked me to record a short interview on a professional development topic. He planned to post it online for Association YPs. I think these types of updates may be useful on technical topics as well. Our Association will not be able to produce podcasts with the production value of Freakonomics (http://freakonomics.com/archive/) or Revisionist History (http://revisionisthistory.com/) (two of my personal favorites), but could produce something simple with real value. A series of short updates on key priorities from state or local air directors would be topical for many of us. Similarly, sharing of compliance best practices or innovations from companies and consultants may be one way to stay current with technical trends.

I am not as tech savvy as many of our A&WMA members. If you have ideas on ways the Association could leverage technology to better serve our members and a drive to execute those ideas, please drop an A&WMA Board member a note or call. If you have successful examples from your Section or Chapter, please share them.

Thanks for your service as environmental professionals and A&WMA members. **em**

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Federal and State Perspectives

on National Ambient Air Quality Standards

This issue of *EM* focuses on the U.S. Clean Air Act (CAA) National Ambient Air Quality Standards (NAAQS) program. Authors from the federal government (U.S. Environmental Protection Agency, or EPA) and three state associations—Association of Air Pollution Control Agencies (AAPCA); National Association of Clean Air Agencies (NACAA); and Western States Air Resources Council (WESTAR)/Western Regional Air Partnership (WRAP)—discuss various NAAQS science and policy topics.

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This issue presents federal and state perspectives on NAAQS issues. In the first article, Alexander Dominguez and Clint Woods of EPA discuss the agency's efforts to review and reform the NAAQS program, including a "back-to-basics" approach for NAAQS standard setting, designations, and implementation. An April 2018 Presidential memorandum is reviewed, which set forth nine primary directives intended to ensure EPA's efficient and cost-effective implementation of air quality standards and regional haze programs. Timeliness, cooperative federalism (working with state co-regulators), and recognition of international and background sources of pollution are critical issues the agency is directed to address.

The authors also discuss EPA's May 2018 memorandum, *Back-to-Basics Process for Reviewing National Ambient Air Quality Standards*, which directs the agency and its independent science advisors to follow five principles for a transparent, timely, and efficient process in reviewing and revising future public health- and welfare-based NAAQS. The authors present important milestones in implementing NAAQS, such as goals for reducing the number of non-attainment areas, reducing the backlog in state plan submissions, and actions related to exceptional events, international sources, interstate transport, state plans, etc.

In the next article, Jason Sloan, Stuart Spencer, and Nancy Vehr of AAPCA (a national organization of more than 20 state environmental agencies and additional local air agencies) focus on air quality improvements in the United States, and the role of states and local air agencies responsible for implementing the NAAQS through the CAA's framework of cooperative federalism. In April 2017, AAPCA published the inaugural edition of *The Greatest Story Seldom Told: Profiles and Success Stories in Air Pollution Control*, an annual report that highlights air quality trends, and underscores the critical role of state and local air agencies in making complex regulatory decisions impacting their communities. The 2018 edition of AAPCA's report, published in July, includes updated trends for criteria pollutant concentrations and emissions that show continued progress.

The authors discuss opportunities for continued air quality success as state and local agencies continue to work toward attaining national standards and characterizing air quality. AAPCA-conducted surveys of state environmental agency comments recognized several common concerns when it comes to establishing compliance with new NAAQS. For example, of 44 state environmental agencies that filed individual comments, 26 state agencies raised background ozone (O_3) as an achievability or implementation challenge, including both naturally occurring and internationally transported contributions to ground-level O_3. The authors state that continued success is dependent on informed collaboration at the federal, state, and local levels.

Next, Miles Keogh of NACAA (a national association of 156 state and local air pollution control agencies in 41 states, the District of Columbia, and four territories) observes that since 1970, the United States has made tremendous strides in reducing levels of the criteria pollutants for which NAAQS are established, driven by the scientific evidence that there are serious health consequences associated with exposure to these pollutants.

The article then focuses on EPA's April 30 proposed rule, "Strengthening Transparency in Regulatory Science." While EPA has stated that its intent with the proposed rule is to increase the quality and transparency of the agency's decision-making, the author says that it is possible that the provisions of the science proposal would weaken both, and many unknowns remain that should be fleshed out. Further, while there is a laudable long-term trend toward increased transparency in science, complete public access to underlying data is not always possible, especially in the case of epidemiological studies based on private health data that must remain confidential. The author concludes by observing that the NAAQS remain a key component of the hard-won clean air gains of recent decades, and diminishing the science used to understand the health implications that drive these standards would harm the health of Americans.

The final article by Mary Uhl of WESTAR and Tom Moore of WRAP (a forum of 15 western states and federal land management partners, and a partnership of states, tribes, federal land managers, local air agencies, and EPA, respectively) addresses NAAQS implementation issues in the Western United States, especially background O_3 and O_3 transport issues. As the O_3 NAAQS have changed in form and stringency over the past two decades, rural areas with high concentrations of O_3 and low numbers of local sources likely responsible for elevated O_3 concentrations have brought a new focus on the analysis of transport, uncontrollable sources of O_3 precursors and background O_3. Western planning needs also include identification of O_3 exceptional events, and clarification of the application of planning mechanisms offered in the CAA (i.e., international transport in Sec. 179B Demonstrations and Sec. 182 Rural Transport Areas).

The authors observe that EPA's funding support in the East has advanced understanding by eastern states of the origin of O_3 precursors, O_3 formation and the fate of O_3, which helped with the development andimplementation of meaningful and effective regulatory programs to improve air quality. Western states need a better understanding of the origin of O_3 precursors, photochemical activity, and fate of transported O_3 to develop and implement effective regulatory programs.

Some NAAQS Observations

Since soon after the CAA's NAAQS provisions were established in 1970, improving air quality and declining emissions have been a constant. For example, according to EPA, from 1990 to 2017 electric power sulfur dioxide (SO_2) and nitrogen oxides

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emissions have been reduced consistently over time, by 92 and 84 percent, respectively, supporting the nation's progress in meeting the SO_2, nitrogen dioxide (NO_2), O_3, and fine particle ($PM_{2.5}$) NAAQS.

Another constant is that the NAAQS process is a never-ending cycle of reviewing and often revising standards; updating implementation rules and guidance; improving air quality models and related tools; updating state plans and industry requirements; and litigation. This process delivers air quality improvements, but further process refinements to reduce time and increase efficiency could benefit federal and state regulatory agencies, regulated industry, and the public.

A final constant is that the NAAQS field is broad. Therefore, numerous important activities could not be addressed in this issue of *EM*; these include:

- Implementation of the 2015 O_3 NAAQS (including addressing the controversial court decision regarding implementation of the 2008 NAAQS) and litigation of the level of the 2015 O_3 NAAQS;
- Retention of the 2010 1-hr NO_2 NAAQS in 2018 and proposed retention of the 2010 1-hr SO_2 NAAQS to be finalized by early 2019;
- Updated reviews of the O_3 and $PM_{2.5}$ NAAQS to be completed in 2020;
- Final designations in 2020 for the 2010 1-hr SO_2 NAAQS;
- Evaluation of secondary NAAQS for SO_2, NO_2, and $PM_{2.5}$;
- Improvements in air quality models, modeling guidelines, and tools to streamline and make air quality permitting more accurate and efficient;
- Addressing interstate transport, including litigation of the "CSAPR Update" rule, EPA responses to state CAA Sec. 126 and 176 petitions and related litigation, addressing state plans for full compliance with Good Neighbor provisions for the 2008 O_3 NAAQS, and the new approach to state plans to address Good Neighbor state plans for the 2015 O_3 NAAQS, through state-by-state plan submissions instead of EPA regional rulemaking;
- Advance notice of proposed rulemaking on increasing consistency and transparency in considering costs and benefits of the rulemaking process; and
- Congressional consideration of legislation addressing the NAAQS review process, permitting and international emissions.

Look for the December issue of *EM* to continue the discussion of NAAQS issues. **em**

John Kinsman is Senior Director, Environment with the Edison Electric Institute, and Chair of *EM*'s Editorial Advisory Committee. E-mail: **jkinsman@eei.org**.

2019 Specialty Conference Call for Abstracts

Guideline on Air Quality Models

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Suggested topics: Ambient Air Monitoring • Coarse and Fine Particulate Matter • Stationary Sources • Data Quality • Mobile Monitoring Platforms • Optical and Optical Remote Monitoring • Low-cost Sensors • Passive Measurements and Fence Line Monitoring • Air Toxics Measurement Methods • Continuous HAP Monitoring, and more.

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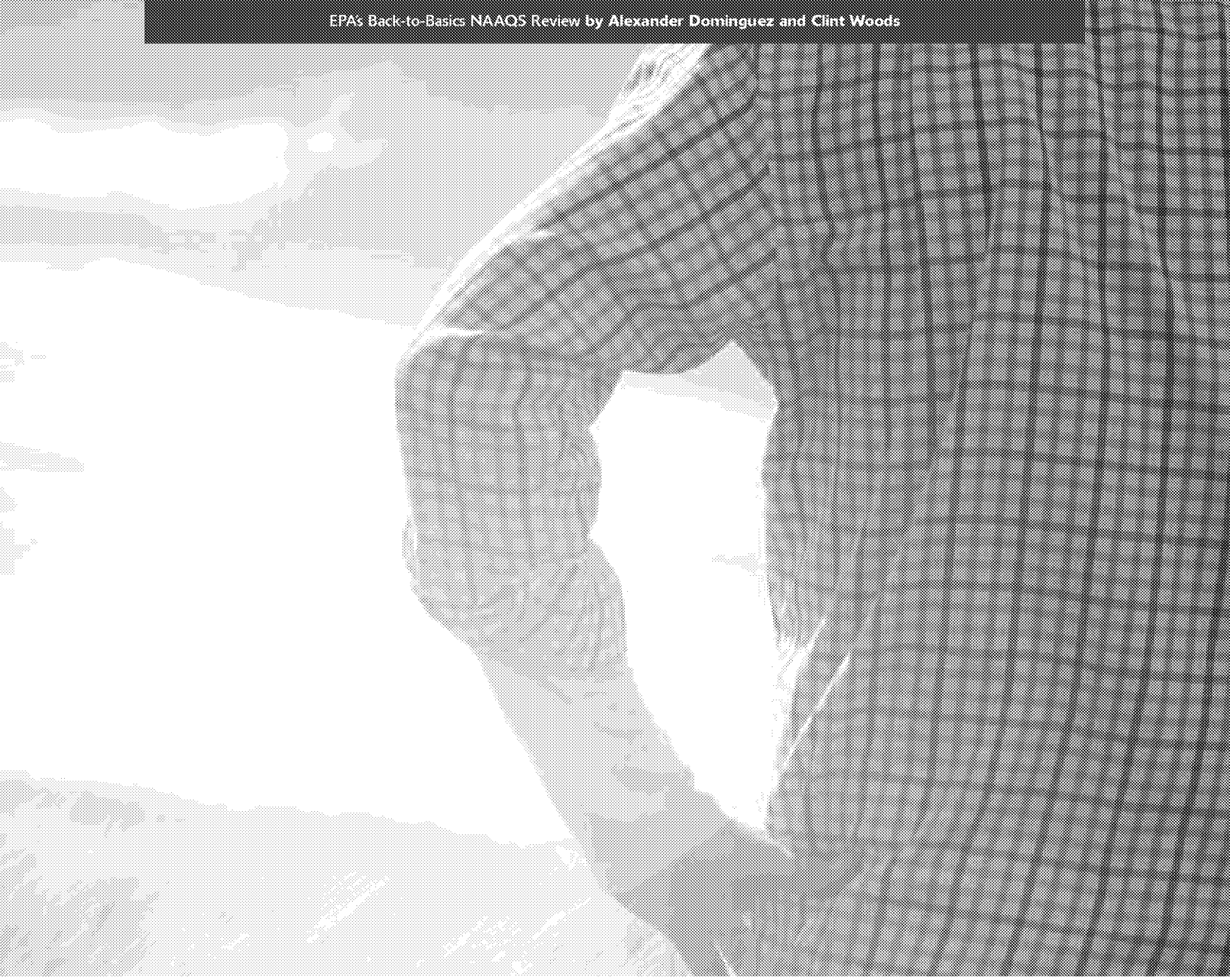

EPA's 'Back-to-Basics' Process for Review of the National Ambient Air Quality Standards

A primer of EPA's process for reviewing the National Ambient Air Quality Standards.

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Consistent with the Administration's commitment to regulatory reform, cooperative federalism, and domestic manufacturing, the U.S. Environmental Protection Agency (EPA) is working to review and reform the National Ambient Air Quality Standards (NAAQS) program of the U.S Clean Air Act (CAA). These efforts include a focus on getting "back-to-basics" for NAAQS setting, designations, and implementation. The United States has experienced tremendous progress in reducing the emission of criteria pollutants and their precursors. Still, challenges remain, both in implementing a number of increasingly stringent NAAQS and in undertaking several upcoming NAAQS reviews. This presents the agency with a unique opportunity, given the direction it has received from the President, to make meaningful changes to the program that, while consistent with EPA's responsibility under the CAA to support public health and the environment, will also ensure a timely, efficient, and transparent process that both respects state agency resources and facilitates robust economic activity.

Background

As readers of *EM* likely know, EPA sets primary and secondary NAAQS for criteria air pollutants that include ozone, nitrogen dioxide, sulfur dioxide, coarse and fine particulate matter, carbon monoxide, and lead. Primary NAAQS are set, based on the judgment of the EPA Administrator and allowing for an adequate margin of safety, at a level to protect the public health. Secondary NAAQS are set at a level to protect the public welfare, which may include effects on soils, water, crops, vegetation, and visibility from the presence of the pollutant in the ambient air. These standards are to reflect the best current scientific information. Under the CAA, EPA is required to review each NAAQS every five years. However, EPA has often failed to do so, sometimes taking twice that amount of time before finalizing a review and any accompanying revision. These delays result in uncertainty as well as lost opportunities for implementing the NAAQS to protect health and the environment in a manner compatible with a vibrant U.S. economy.

In setting the NAAQS, the EPA Administrator receives advice from a critical federal advisory committee established by the CAA, the Clean Air Scientific Advisory Committee (CASAC). EPA staff in the Offices of Research and Development and Air and Radiation develop a comprehensive scientific and technical assessment, which CASAC then reviews in the process of providing advice to the Administrator. Having received this expert advice, EPA publishes a notice of proposed rulemaking and solicits public comment on the Administrator's proposal. After taking into consideration all of the significant public comments received, the Administrator reaches a final decision and issues a final rule either to maintain the current NAAQS or to set a revised standard. Where EPA sets a new NAAQS or revises an existing standard, then the Agency is required within two years, after taking into consideration the recommendations of governors, to designate areas as either attaining or not attaining the standard.

Each NAAQS revision requires significant new planning and permitting for states and regulated entities. In particular, a nonattainment designation can create challenges for the construction or expansion of industrial facilities. Under the NAAQS program, EPA and states cooperate as co-regulators to carry out the CAA's mission of protecting human health and the environment. Implementation of the standards must be accomplished in a manner that is both consistent with the principles of cooperative federalism and which also complies with statutory requirements.

Back-to-Basics

In April 2018, the President issued a memorandum, Promoting Domestic Manufacturing and Job Creation –

The themes of timeliness, cooperative federalism, and recognition of international and background sources of pollution are critical issues EPA is directed to address to ensure states can successfully implement the standards.

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Table 1. April 2018 Presidential Memorandum Topics

Timely Processing of State Implementation Plans
Cooperative Engagement with States to Review Regional Haze Plans
Timely Processing of Preconstruction Permit Applications
Demonstrations or Petitions Submitted Pursuant to Sections 319 and 179B of the CAA Relating to Emissions Beyond the Control of State and Local Air Agencies
Monitoring and Modeling Data
Offsets
Future NAAQS Reviews
Timely Issuance of Implementing Regulations and Guidance
Review of Rules, Guidance, Memoranda, and Procedures Relating to State Implementation Plans and Permitting

Policies and Procedures Relating to Implementation of Air Quality Standards (https://www.gpo.gov/fdsys/pkg/DCPD-201800239/pdf/DCPD-201800239.pdf). This memorandum set forth nine primary directives intended to ensure EPA's efficient and cost-effective implementation of air quality standards under the NAAQS and regional haze programs. These directives are outlined in Table 1. The themes of timeliness, cooperative federalism, and recognition of international and background sources of pollution are critical issues the Agency is directed to address to ensure states can successfully implement the standards.

To advance the initiatives set out in the presidential memorandum, EPA has issued its own memorandum, Back-to-Basics Process for Reviewing National Ambient Air Quality Standards, (https://www.epa.gov/sites/production/files/2018-05/documents/image2018-05-09-173219.pdf) In May 2018. EPA's memorandum directs the agency and its independent science advisors to follow five principles for a transparent, timely, and efficient process in reviewing and revising future public health- and welfare-based NAAQS.

Principle 1: Meet Statutory Deadlines

As noted above, EPA routinely fails to meet the CAA requirements to review each NAAQS every five years. These delays result in uncertainty as well as lost opportunities for implementing the NAAQS to protect health and the environment in a manner compatible with a growing American economy. EPA and CASAC are encouraged to look for efficiencies and opportunities to streamline the NAAQS review process to ensure that it is completed within the statutorily-mandated five-year period. EPA's Back-to-Basics memorandum also directs the agency and CASAC to ensure that any potential revisions to the NAAQS for ozone or particulate matter, last set in 2015 and 2012 respectively, be finalized by late 2020.

Principle 2: Address CAA Provisions for NAAQS Reviews

While the CAA clearly identifies the roles and responsibilities of CASAC in providing important advice in the review of air quality criteria, EPA has frequently failed to request that the committee provide advice with respect to all of the CASAC duties to which the statute specifically speaks. For example, Section 109(d)(2)(C) requires CASAC to advise the Administrator on the "relative contribution to air pollution concentrations of natural as well as anthropogenic activity," as well as "any adverse public health, welfare, social, economic, or energy effects which may result from various strategies for attainment and maintenance of such" NAAQS. To address these past failures, EPA intends to provide CASAC with a standardized set of key charge questions so that the entirety of the NAAQS review process is properly framed. While certain of these charge questions may elicit information which is outside the scope of the Administrator's standard-setting authority itself, such information, by providing important contextual insights, should nevertheless prove valuable to the public, co-regulators, EPA, and other policymakers.

Principle 3: Streamline and Standardize the Process for Development and Review of Key Policy-Relevant Information

CASAC has frequently identified reducing the length and complexity of the scientific assessments as a key process improvement for streamlining NAAQS reviews and ensuring the Agency adheres to the statutory deadlines. To help bridge the gap between the scientific assessments and the

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judgments required of the Administrator, the memorandum recommends incorporating policy-relevant science earlier into the review process. EPA is also directed to ensure that the initial drafts of all technical and policy assessments are high quality and ready for robust review from CASAC and the public.

Principle 4: Differentiate Science and Policy Considerations in NAAQS Review Process

The Back-to-Basics memo directs EPA to establish a clearer distinction between its scientific findings (contained in the Integrated Science Assessment) and the wider range of policy concerns that the Administrator may consider in judgments about the level of the NAAQS. CASAC and EPA should seek to find consensus, but should allow for individual advisors to share their individual perspectives.'

Principle 5: Issue Timely Implementation Regulations and Guidance

When a NAAQS is revised, EPA should strive for expedition in the release of implementation tools for co-regulators, including regulations, guidance, and technical information to assist state agencies in developing approvable plans. In the past, EPA implementation regulations and guidance have often trailed NAAQS revisions by years, which may hinder co-regulators from completing the required steps to administer the NAAQS at the state level. Failure to issue timely implementation regulations and guidance may contribute to nonattainment areas not attaining the NAAQS as quickly as practicable, as well as to the misallocation of state planning resources.

Flexibilities

Based on requirements in the CAA and the President's April 2018 memorandum, EPA has also committed to a number of important milestones in implementing NAAQS collaboratively with the states. Many of these critical measures have been ncorporated in the agency's FY2018–FY2022 strategic plan, as well as other EPA priority documents. These efforts include:

- As an agency priority goal, reducing the number of NAAQS nonattainment areas, including a 20-per cent reduction in these areas in the next few years.
- Addressing the backlog in state implementation plan revision submissions, which the CAA directs EPA to act upon within 18 months of submission.
- Pursuant to Section 319B of the CAA, releasing and communicating a number of tools related to the exclusion of air quality data exceeding the NAAQS when such data result from "exceptional events" outside the control of state, local, or tribal air agencies. Since 2016, EPA has acted upon more than 20 "exceptional event" demonstrations, nearly all of which concurred with state recommendations and thus provided the state with regulatory relief.
- Maximizing states' flexibility to use other tools enabling regulatory relief for appropriate reasons, including CAA provisions to address emissions caused by international sources.
- Working closely with states to facilitate the submission of "Good Neighbor" state implementation plans for the 2015 ozone NAAQS. Under Section 110 of the CAA, states must address in their plans emissions that contribute significantly to nonattainment or interfere with maintenance of the NAAQS in other states.
- Revisiting aspects of the previous Administration's regional haze rule, including identifying flexibilities and technical tools for state plans due in 2021.
- Simplifying the New Source Review process and, by October 2019, reducing by 50 percent the number of permitting-related decisions that exceed six months. **em**

Alexander Dominguez is a Policy Analyst, and **Clint Woods** is Deputy Assistant Administrator, both with the U.S. Environmental Protection Agency's Office of Air and Radiation.

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A Story Seldom Told

National Ambient Air Quality Standards and Success in Air Pollution Control

The Association of Air Pollution Control Agencies reports on trends in U.S. air quality control.

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As a cornerstone of the U.S. Clean Air Act, the National Ambient Air Quality Standards (NAAQS) program has been a vital component in the significant progress that has been achieved in reducing air pollution in the United States. State and local air agencies, responsible for implementing the NAAQS through the Clean Air Act's framework of cooperative federalism, have helped lead this success by developing sensible, localized strategies that address air pollution and respond to unique social and economic factors. In April 2017, the Association of Air Pollution Control Agencies (AAPCA) published the inaugural edition of *The Greatest Story Seldom Told: Profiles and Success Stories in Air Pollution Control,*[1] an annual report that highlights air quality trends, both in the AAPCA footprint and nationally, and underscores the critical role of state and local air agencies in making complex regulatory decisions impacting their communities.

Seeking to catalogue long-term air quality trends through publicly available data from the U.S. Environmental Protection Agency (EPA) and other agencies, AAPCA's annual report includes key metrics on the emissions and ambient concentrations of the six criteria air pollutants for which EPA has set NAAQS: carbon monoxide (CO), sulfur dioxide (SO_2), ground-level ozone (O_3), fine particulate matter ($PM_{2.5}$), lead (Pb), and nitrogen dioxide (NO_2).[2] Annual reports and data analyses that are made available to the public by EPA provide important information on long-term air quality and criteria pollutant trends. These include:

- An analysis (https://www.epa.gov/air-trends) of the ambient air pollution data provided to the national air quality system from thousands of monitors across the United States, collected by EPA, state, local, and tribal air pollution control agencies;
- Air pollutant emissions trends data (https://www.epa.gov/air-emissions-inventories/air-pollutantemissions-trends-data), which provide nationwide estimates of emissions of criteria air pollutants based on the National Emissions Inventory (NEI);[3] and
- Air quality design values (https://www.epa.gov/air-trends/air-quality-design-values), which EPA defines as "a statistic that describes the air quality status of a given location relative to the level of the NAAQS … typically used to designate and classify nonattainment areas, as well as to assess progress towards meeting the NAAQS."[4]

Relying on these reports and analyses, AAPCA's *The Greatest Story Seldom Told* is able to spotlight some of the nation's important air quality successes. The 2018 edition of AAPCA's report, published July 2018, includes updated trends for criteria pollutant concentrations and emissions that show continued progress.

Air Quality Trends

Over the course of the past several decades, ambient concentrations of the six criteria air pollutants have declined substantially. According to EPA's analysis of 2017 monitoring data,[5] there has been at least a 32-percent reduction in the ambient levels of CO, Pb, NO_2, O_3, and SO_2 since 1980, and available monitoring data for fine and coarse particulate matter ($PM_{2.5}$ and PM_{10}) show similar trends. A decade-over-decade comparison demonstrates consistent and consequential changes in ambient air quality since 1980, 1990, and 2000 (see Table 1).

Emissions Trends

Reductions in the emissions of criteria pollutants or criteria

Table 1. A decade-over-decade comparison of ambient air quality since 1980

Pollutant	1980 vs. 2017 (% change)	1990 vs. 2017 (% change)	2000 vs. 2017 (% change)
Carbon monoxide (CO)	-84	-77	-61
Lead (Pb)	-99	-98	-94
Nitrogen dioxide (NO_2; annual)	-63	-56	-49
Nitrogen dioxide (NO_2;1-hr)	-60	-50	-35
Ozone (O_3; 8-hr)	-32	-22	-17
PM_{10} (24-hr)	n/a	-34	-30
$PM_{2.5}$ (annual)	n/a	n/a	-41
$PM_{2.5}$ (24-hr)	n/a	n/a	-40
Sulfur dioxide (SO_2; 1-hr)	-90	-885	-79

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pollutant precursors have contributed to the considerable progress in air quality. Utilizing the NEI, EPA publishes air pollutant emissions trends data that provide annual estimates of criteria pollutant emissions and precursors, distinguished by major sources.

The trends data on emissions published by EPA for 2017 show that, nationally, criteria pollutant emissions and precursors continue to decline.[6] When comparing 1990 to 2017, there has been at least a 29-percent reduction in the emissions of all criteria pollutants or precursors (see Table 2). EPA's 2018 air quality report, entitled Our Nation's Air: Status and Trends Through 2017, (https://gispub.epa.gov/air/trendsreport/2018/) and published as an interactive website, further highlights a 73-percent decrease overall in the combined emissions of criteria pollutants or precursors since 1970.

Social and Economic Growth

Planning for, implementing, and enforcing the NAAQS require that state and local air pollution control agencies not only find ways to reduce emissions and improve air quality, but accommodate the social and economic growth characteristics of their jurisdictions. A more complete profile of air quality nationally can be seen when accounting for the tremendous gains in population, gross domestic product, and other factors—all of which have the potential to impact pollution levels.

Importantly, the trend lines for these social and economic growth indicators are in sharp contrast to the trends of the criteria air pollutants. Using data from the U.S. Census Bureau, U.S. Bureau of Economic Analysis, and U.S. Energy Information Administration, AAPCA's 2017 report charted the significant increases since 1960 in U.S. Gross Domestic Product (436 percent from 1960 to 2016), population (72 percent from 1960 to 2010), and energy production (105 percent from 1960 to 2014). EPA's 2018 air quality report details similar trends since 1970: U.S. Gross Domestic Product has increased by 262 percent, population has grown 59 percent, vehicle miles traveled are up 189 percent, and energy consumption has risen 44 percent.

Table 2. Emissions Trends, 1990–2017

Pollutant	1990 Emissions (in thousands of tons)	2017 Emissions (in thousands of tons)	% Reduction
Carbon monoxide (CO)	154,188	60,109	-61
Oxides of nitrogen (NO_x)	25,527	10,776	-58
$PM_{2.5}$	7,560	5,345	-29
Sulfur dioxide (SO_2)	23,077	2,815	-88
Volatile organic compounds (VOCs)	24,108	16,232	-33

Opportunities for Continued Air Quality Success

While significant progress has been achieved in controlling air pollution at both the state and national level, challenges still exist as state and local agencies work toward attaining national standards and seek to appropriately characterize air quality in their areas.

For example, AAPCA-conducted surveys of state environmental agency comments on EPA's proposed 2015 O_3 standard—the most recent standard to be revised downward—recognized several common concerns when it comes to establishing compliance with new NAAQS.[7]

Of the 44 state environmental agencies that filed individual comments, AAPCA found that:

- 26 state agencies raised background O_3 as an achievability or implementation challenge, including both naturally occurring and internationally transported contributions to ground-level O_3;
- Roughly three-quarters of state agencies raised concerns about the need for timely implementation rules and guidance from EPA under a revised standard; and
- 22 states commented on limitations to activating Clean Air Act tools for excluding data effected by "exceptional events."

Recognizing these vital on-the-ground issues, which are outside of state and local air agency control, highlights the need to establish methods that provide regulatory and other assistance for attaining air quality standards.

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On April 12, 2018, a Presidential Memorandum was issued on "Promoting Domestic Manufacturing and Job Creation—Policies and Procedures Relating to Implementation of Air Quality Standards."[8] This memorandum included directives for EPA that may accommodate some of these environmental agency concerns, as well as better characterize air quality in terms of background concentrations and exceptional events. Other recent policies, such as EPA's October 2017 directive on "Strengthening and Improving Membership on EPA Federal Advisory Committees,"[9] have sought to broaden input earlier in scientific and regulatory processes by increasing state, tribal, and local membership, as well as enhancing geographic diversity. Engaging state and local air agencies is critical as these policies are carried out, especially as EPA begins to implement recently announced policy changes to the NAAQS standard-setting process and works to complete reviews of the current O_3 and $PM_{2.5}$ standards by 2020.[10]

Continued success reflective of the long-term trend in air quality is dependent on informed collaboration at the federal, state, and local levels. As the Environmental Council of States indicates in its Cooperative Federalism 2.0 paper, "States are a critical part of achieving our nation's environmental and public health goals and mandated responsibilities in an effective and efficient way."[11] Further, as AAPCA indicated in comments on EPA's *Draft FY 2018–2022 EPA Strategic Plan*, "State and local agencies are often the first point of contact for community air quality concerns."[12] Involving the agencies directly responsible for implementing air quality standards and responding to public concerns early in the regulatory and decision-making process can provide opportunities to better define, understand, and, ultimately, find solutions to the complex issues facing the nation's air quality—and continue the positive trends the nation has witnessed in air quality over the past 40 years. **em**

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AAPCA is a national, nonprofit, consensus-driven organization focused on assisting state and local air quality agencies and personnel with implementation and technical issues associated with the U.S. Clean Air Act. AAPCA represents more than 40 state and local air agencies, and senior officials from 20 state environmental agencies currently sit on the AAPCA Board of Directors. AAPCA is housed in Lexington, KY, as an affiliate of The Council of State Governments.

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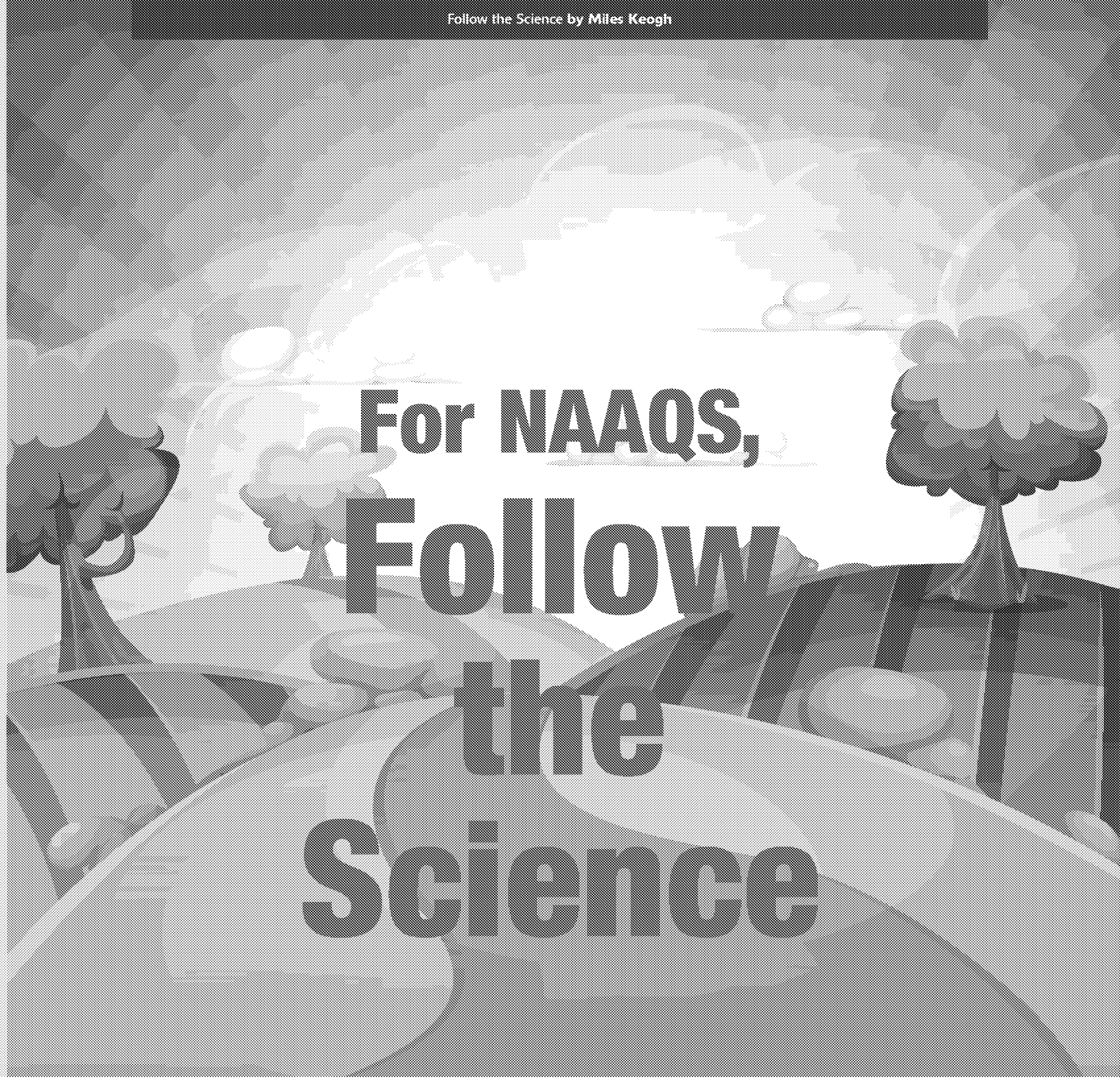

For NAAQS, Follow the Science

The National Association of Clean Air Agencies comments on EPA's April 30, 2018 regulatory proposal, "Strengthening Transparency in the Regulatory Science."

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In an April 2018 regulatory proposal, the U.S. Environmental Protection Agency (EPA) wrote that "the best available science must serve as the foundation of EPA's regulatory actions."[1] Indeed, reliance on best-available science is a fundamental requirement of the U.S. Clean Air Act and other environmental statutes that EPA administers in partnership with state and local governments. Science-based decision-making is at the very core of our shared mission as air regulators to protect public health and the environment from the harmful effects of air pollution.

The National Ambient Air Quality Standards (NAAQS) are a central example of sound science-driven policy. The Clean Air Act requires EPA to establish NAAQS at levels "requisite to protect the public health" with "an adequate margin of safety." In meeting this obligation, EPA is required to develop air quality criteria that *"accurately reflect the latest scientific knowledge* useful in indicating the kind and extent of all identifiable effects on public health or welfare which may be expected from the presence of such pollutant in the ambient air, in varying quantities."[2]

EPA's own research from 2011 showed that the science-driven implementation of pollution control programs for ozone and particulates under the NAAQS will prevent over 230,000 premature deaths in adults and infants in 2020.[3] Since 1970, the United States has made tremendous strides in reducing levels of the "criteria pollutants" for which NAAQS are established; those improvements have been driven by the scientific evidence that there are serious health consequences associated with exposure to these pollutants.

On April 30, 2018, EPA published a proposed rule, Strengthening Transparency in Regulatory Science,"[4] that could change the way that science is used by the agency to set and implement air pollution prevention programs like the NAAQS. State and local clean air agencies depend on EPA to use the best scientific information to set health-based standards, which are then implemented in the first instance by state and local agencies for the health and wellbeing of Americans. The NAAQS are directly implicated in this proposal.[5]

EPA has stated that its intent with the proposed rule is to increase the quality and transparency of the agency's decision-making. However, it is possible that the provisions of the science proposal would weaken both, and many unknowns remain that should have been fleshed out before the rule was proposed. The proposal includes three main components. First, it would require EPA to ensure that the data and models underlying the scientific studies on which its regulatory actions are based are "publicly available in a manner sufficient for independent validation."[6] Second, it would impose upon the agency requirements for the analysis of dose—response models used in scientific studies upon which it relies.[7] Third, it would require EPA itself to conduct "independent peer review" of scientific studies used to justify its regulatory decisions.[8]

There is a laudable long-term trend toward increased transparency in science—in particular, toward providing greater public access to underlying data and analytical techniques after scientific studies are published.[9] But complete public access to underlying data is not always possible, especially in the case of epidemiological studies based on private health data that must remain confidential. To the extent that techniques are available to anonymize such data, efforts to support and further develop those techniques should be encouraged. In the meantime, however, insistence that every datum must be universally available must not override EPA's legal and moral obligation to consider the full range of peer-reviewed, sound scientific research that is available and relevant to its regulatory decisions.

Full public access to underlying data and models is not necessary to assure the validity of scientific studies.[10] Rather, the most effective assurance of scientific validity and accuracy is the process of peer review itself, a process to which the vast majority of scientific information on which EPA relies has already been subject. There are many steps involved in this process. Scientists collect data, analyze them, create a model to test theories, compare the model to the data, and then adjust the model. When the results of a scientific study are submitted for publication, the uncertainties, assumptions,

The most effective assurance of scientific validity and accuracy is the process of peer review itself.

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parameters, and theories utilized by the scientists are laid out in the publication. Peer review analyzes all these components to establish validity. This process of peer review has been rigorously developed over centuries. If EPA believes the peer review process is flawed, it is incumbent on the agency to explain exactly why it believes the process is inadequate and how its proposal specifically addresses those inadequacies.

The proposal fails to acknowledge that EPA already has the institutional mechanisms to review and vet scientific information through panels of scientific experts. The primary function of EPA's Science Advisory Board (SAB) is to review the quality and relevance of scientific and technical information being used by EPA or proposed as the basis for EPA regulations. EPA's Clean Air Scientific Advisory Committee (CASAC) provides independent advice to the EPA Administrator on the technical bases for the NAAQS. Similarly, the Federal Insecticide, Fungicide, and Rodenticide Act Scientific Advisory Panel provides independent scientific advice on the health and safety issues related to pesticides. By ignoring the existence of these bodies in the proposed rule, EPA suggests that it does not trust its own scientific advisors. This tends to undermine public confidence in EPA decision-making, rather than to bolster it.

Of critical concern to air regulators, the proposal could serve to preclude EPA's consideration of relevant scientific literature in the establishment of air regulations designed to protect human health and the environment. Taking one key example, a broad range of concerns has been raised that the landmark Harvard School of Public Health "Six Cities" epidemiological study, which established the strong association between fine particulate matter pollution and mortality, could potentially be excluded for failing to meet the stringent transparency requirements of the proposed rule because it relies on human health data subject to patient confidentiality agreements that were entered into decades ago.

The proposal would also allow the EPA Administrator to grant exemptions to the rule's requirements on a case-by-case basis if he or she determines it is "not feasible" to make underlying data publicly available or to conduct independent peer review of scientific studies. However, this provision does not alleviate concerns about the potential exclusion of relevant data, because the proposal does not include any criteria for how the Administrator would make such a determination. The provision would thus have the unwelcome effect of interjecting the appearance of politics into what should be a fair and unbiased assessment. It is an opportunity for arbitrary decision-making and is wholly insufficient to protect against the exclusion of relevant, valid scientific studies.

The proposed rule would require EPA to conduct "*independent* peer review" [*emphasis* added] of scientific studies underlying its significant regulatory decisions, such as the establishment of health-based air quality standards. Unfortunately, EPA has included no details about how this element of the proposal would be implemented. With respect to the NAAQS in particular, what relationship would this review process have to the role played by the CASAC? More fundamentally, why should scientific literature that has already undergone peer review and been vetted by EPA's science advisory panels be subjected to an additional layer of "independent" review? These are key questions that should have been considered, and the answers made public, prior to the science rule's proposal.

The proposal offers that the direction suggested by EPA is consistent with the Administrative Procedure Act, the guidance of the Office of Management and Budget, and other federal transparency and data laws. However, it outlines requirements that are actually out of sync with these laws, which could possibly result in the exclusion of the best data to inform the most appropriate policy. Even the U.S. Food and Drug Administration does not require this level of disclosure and data exclusion—no other federal agency does. Numerous public health experts have raised concerns that confidential personal information would be at risk—or perceived by study participants to be at risk—if the proposal were to be implemented. EPA offers that concerns about information disclosure can be addressed using tools available through other federal programs, but such tools have not been enumerated, which raises issues about the easy identification of study participants and the negative impact on the quality of research and its potential to be included in the setting of public policy.

EPA implies that the rule would be implemented "over time" and prospectively, but also requests comment on whether there would be value to applying requirements of the science proposal retrospectively. The agency asks whether for regulatory programs like the NAAQS, in which future significant regulatory actions may be based on the administrative records from previous reviews, the final rule should apply to that previous administrative record. Existing programs should not be opened to retrospective review under this rule. To do so would create significant regulatory uncertainty by calling into question existing regulatory standards, as well as the permits, state implementation plans, and other decisions that are based on those standards. Applying these rules to data and models in underlying studies that have already been completed or are currently underway would be detrimental to the certainty on which businesses and citizens alike depend. Moreover, in the case of the NAAQS, iterative five-year reviews provide an opportunity for ongoing and comprehensive review of the literature. This already allows EPA to evaluate the veracity and any uncertainties in past studies in relation to current ones.

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NACAA has a long history of supporting EPA actions that rely on the most recent scientific evidence to establish any primary and secondary NAAQS to protect public health and welfare, respectively, and the agency's reliance on advice from its own science advisory committees like CASAC.[11] Regulations with such significant ramifications for EPA's science-based decision-making and for weighing the benefits of wide-ranging programs must be thoroughly vetted *prior to proposal* by the scientific community, industry, consumer advocates, and other key stakeholders, including the state and local air agencies that rely on the quality of EPA's regulations to protect public health and the environment from the harmful effects of air pollution. The NAAQS remain a key component of the hard-won clean air gains of recent decades, and diminishing the science used to understand the health implications that drive these standards would harm the health of Americans. The proposal should be withdrawn and any future similar proposal should be fully informed through a transparent, pre-proposal process, and better considered by decision-makers at EPA. **em**

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Disclaimer: This article is based on NACAA's July 2018 comments to the U.S. Environmental Protection Agency (EPA) on the agency's April 30, 2018, regulatory proposal, "Strengthening Transparency in the Regulatory Science," but includes additional perspectives that are the author's alone.

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5. *Note:* EPA's proposal specifically notes: "For regulatory programs, like the National Ambient Air Quality Standards program, in which future significant regulatory actions may be based on the administrative record rom previous reviews… EPA seeks comment on the manner in which this proposed rule should apply to that previous record."
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10. *Note:* EPA's own science advisors acknowledge this point. In a recent memorandum, a Science Advisory Board (SAB) Work Group Chair elaborated on this and many other concerns with the proposed rule. The Work Group concluded that the action warrants further review by the SAB. See Memorandum to Members of the Chartered SAB and SAB Liaisons from Alison Cullen, Chair, SAB Work Group on EPA Planned Actions for SAB Consideration, "Preparations for Chartered Science Advisory Board (SAB) Discussions of Proposed Rule: Strengthening Transparency in Regulatory Science RIN" (May 12, 2018), at 4 (available at https://yosemite.epa.gov/sab/sabproduct.nsf/E21FFAE956B548258525828C00808BB7/$File/WkGrp_memo_2080-A14_final_05132018.pdf).
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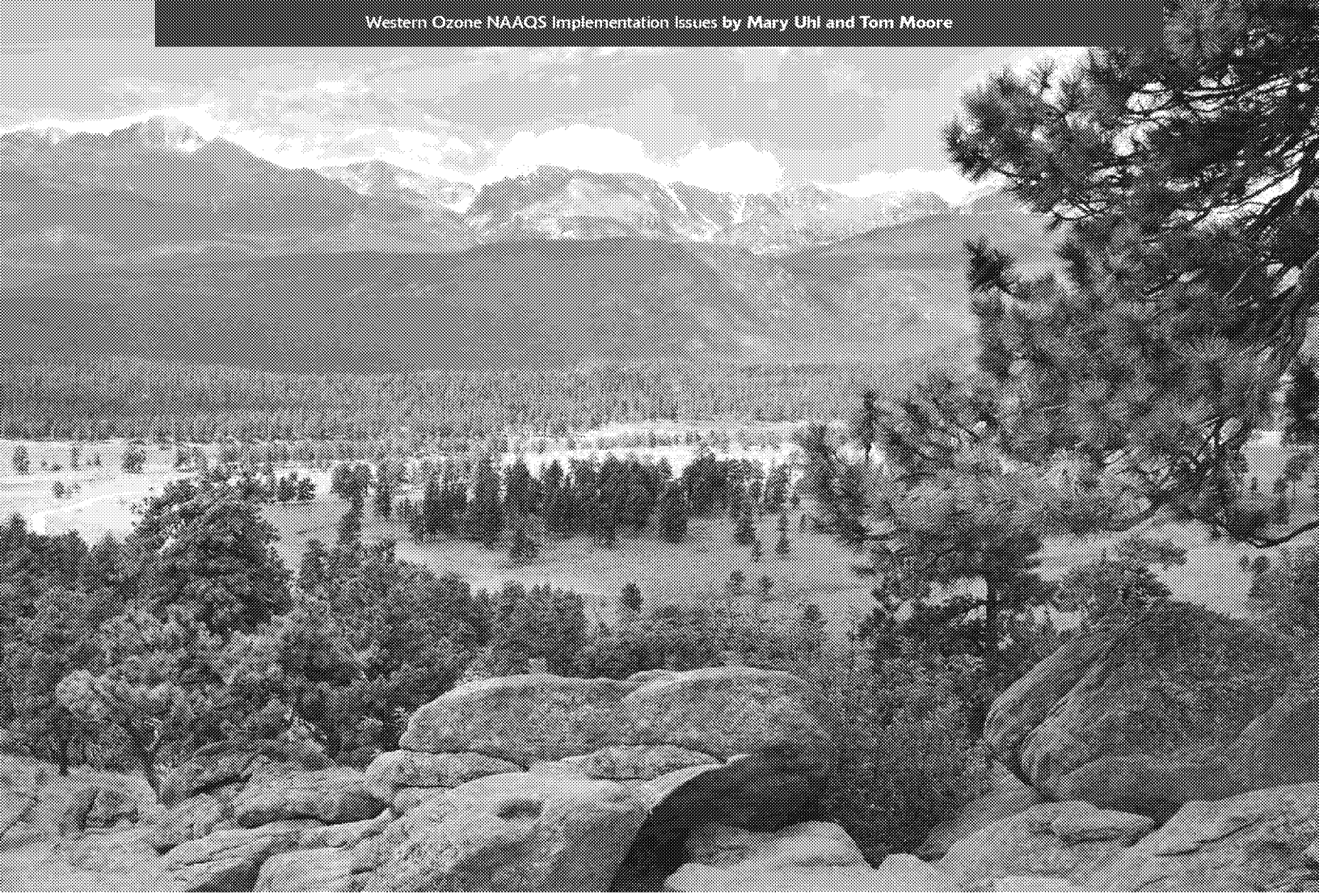

Western Ozone NAAQS Implementation Issues:

Addressing Background and Transport

As the National Ambient Air Quality Standards (NAAQS) for ozone (O_3) have changed in form and stringency over the past two decades in order to protect health and welfare, western states have had to move quickly to understand and respond to non-urban areas with O_3 concentrations nearing the federal NAAQS, as well as the background and transported O_3 affecting existing nonattainment areas from beyond those areas' boundaries.

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Rural areas with high concentrations of O_3 and low numbers of local sources likely responsible for elevated O_3 concentrations have brought a new focus on the analysis of transport, uncontrollable sources of O_3 precursors, and background O_3. More stringent O_3 NAAQS have also necessarily led to further analysis of background and transported O_3 affecting existing nonattainment areas. Other western planning needs such as identification of both controllable and uncontrollable sources contributing to O_3 transport, identification of O_3 exceptional events (EEs), and clarification of the application of planning mechanisms offered in the U.S. Clean Air Act (international transport §179B demonstrations and §182 Rural Transport Areas) all depend on accurately quantifying background O_3. Western states need detailed O_3 analyses focusing on the western United States to gain a better understanding of the origin of O_3 precursors, photochemical activity, and fate of transported O_3 with a level of confidence that will lead to the development and implementation of effective regulatory programs for the West.

The U.S. Environmental Protection Agency (EPA) defines U.S. background (USB) O_3 to be any O_3 formed from sources or processes other than U.S. manmade emissions of nitrogen oxides (NOx), volatile organic compounds (VOCs), methane (CH_4), and carbon monoxide (CO).[1] In the West, USB sources may include international transport of O_3 precursors, stratospheric intrusion, lightning, biogenic emissions, and wildfire. Along the West Coast, seasonal USB O_3 mean concentrations are in the range of 30–50 parts per billion (ppb).[2] Levels of USB O_3 in remote intermountain west high-altitude locations, including many intermountain national parks, significantly contribute to the overall O_3 concentrations measured.

Table 1 shows O_3 design values (ODV) at paired monitoring sites for the maximum daily 8-hr average (MDA8) value, the compliance statistic for the O_3 NAAQS. Note that for these paired nearby locations within each state, higher elevation sites have higher design values attributable to higher USB O_3. In each state, the lower elevation site is in a small urban or rural location, while the elevated site is more remote. The large USB O_3 signal relative to the compliance level of the O_3 NAAQS (0.070 parts per million, ppm) for rural and remote sites, which are typical of large areas of the West, complicates the task of western air regulatory agencies to meet federal air quality requirements, including attainment and maintenance of the O_3 NAAQS and issues with determination of O_3 transport into the United States and/or between states. The accurate identification and quantification of USB O_3, as well as a correct representation of atmospheric chemistry and transport, are necessary to determine what control measures for local sources will be effective in reducing ambient O_3. As discussed below, quantifying USB O_3 is challenging.

Characterizing Ozone for Air Quality Planning Decisions in the West

Primary tools used by states and EPA to manage air quality are the State Implementation Plans (SIPs)[3] or Federal Implementation Plans (FIPs). These documents are federally-enforceable plans developed by and/or for states that identify how the state will attain and/or maintain the air quality standards. A key component of each SIP is the maintenance of a network of regulatory O_3 monitors operated by the state that use standardized sampling methodologies, quality assurance, and siting requirements established by EPA, along with complementary monitors operated by other federal,

Table 1. Comparison of O_3 ODVs for adjacent sites with differences in elevations >1,000 m (2013–2015)[a]

State	Site	Coordinates	Meters ASL	O_3 Design Value (ppb)[b]
Oregon	Bend	44.02°N, 121.26°W	1,135	59
Oregon	Mt. Bachelor	43.98°N, 121.69°W	2,763	77
Wyoming	Carbon	41.78°N, 107.12°W	2,015	55
Wyoming	Centennia	41.36°N, 106.24°W	3,178	66

Notes:
a Data are from EPA Air Quality System (AQS) database (https://www.epa.gov/aqs) except for the non-regulatory Mt. Bachelor measurements, which are from the University of Washington data archive (https://digital.lib.washington.edu/Researchworks).
b The MDA8 values used in the ODV calculations are only the data acquired with start hours between 0700 and 2300 local standard time. The ODV is the three-year average of the 4th highest annual MDA8, calculated after approved EE data have been excluded from AQS. For all sites listed here, no EE days were identified or excluded from the ODV calculation. Note that EEs have not been formally evaluated for the Mt. Bachelor data, since it is not a regulatory monitor.

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tribal, and local agencies. Knowledge of the sources contributing to the ambient levels on the highest O_3 days is important because controlling the domestic contribution to O_3 production affects the estimates of both the health benefits and the economic costs and benefits associated with achieving the NAAQS.[4] This knowledge is also important for SIP development because it helps states identify the most effective emission control strategies.

Quantifying USB O_3 requires a complicated mix of modeling and evaluation using observational data; however, missing pieces of scientific understanding of some sources of O_3 precursors such as wildfire, stratospheric intrusion, and international/interstate transport hinder the use of these data for air quality planning and affects the accuracy of results. Most O_3 monitoring in the United States is accomplished in urban areas or in those rural areas with significant influence from nearby, O_3 precursor sources such as oil and gas production areas in the Intermountain West. There are few monitors along the West Coast in remote locations that might be considered representative of the USB O_3 entering the western United States.

Air quality computer models require accurate emissions, comprehensive representation of physical and chemical processes in the atmosphere, and the ability to replicate plume dispersion to yield useful results. There are several modeling approaches that have been employed to quantify USB O_3, and each approach has strengths and weaknesses. The resolution of O_3 NAAQS compliance planning issues becomes difficult due to two major factors: (1) USB O_3 contributes substantially to monitored concentrations, quantification methodologies are lacking necessary analytical capabilities, and have substantial uncertainties; and (2) air regulators are able to evaluate and further control the relatively small fractions of controllable local precursors contributing to monitored O_3 levels in their plans to reduce O_3 levels. Figure 1 demonstrates this complexity with conceptual models for O_3 sources (a) in the United States and (b) at a single location.

The trend in the annual fourth highest daily average 8-hr O_3 concentration for 2000–2017 for nine urban U.S. locations—San Bernardino, Chicago, Atlanta, Boston, Albuquerque, Sacramento, Salt Lake City, Denver, and Reno—is presented

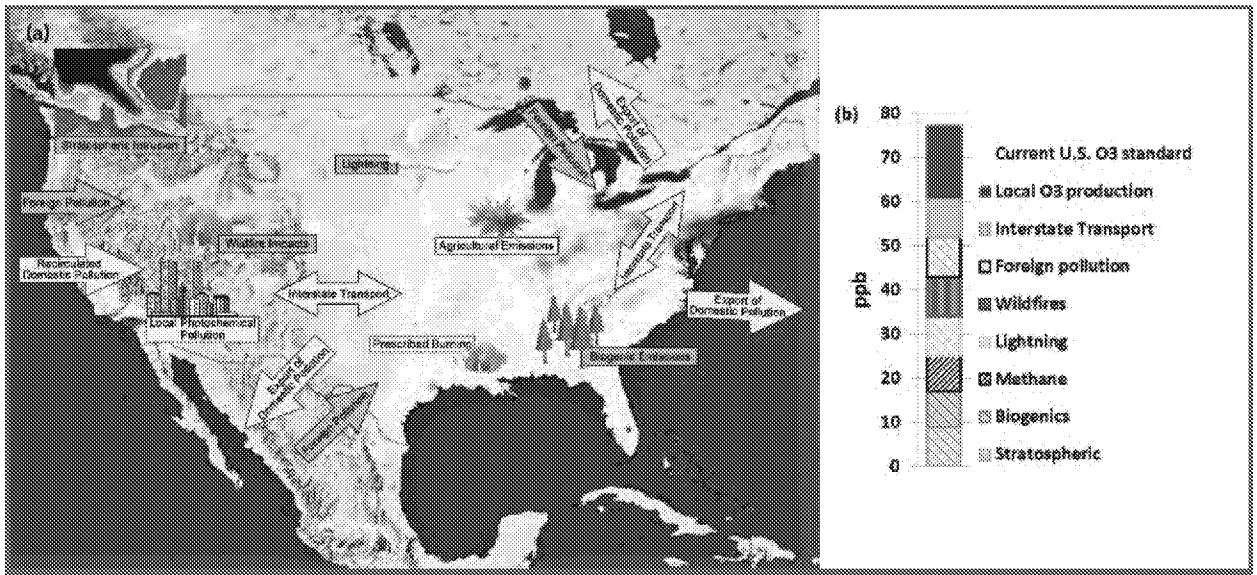

Figure 1. Conceptual models for O_3 sources (a) in the United States and (b) at a single location.

Notes:
(a) The U.S. O_3 sources shown with yellow boxes or arrows represent domestic/controllable anthropogenic sources. Sources shown with blue boxes or arrows represent USB/uncontrollable sources. Note that locations for each process are not specific to any one region. The base map shows satellite-observed tropospheric nitrogen dioxide (NO_2) column concentrations for 2014 from the Ozone Monitoring Instrument (OMI) onboard the NASA Aura satellite (*Credit*: NASA Goddard's Scientific Visualization Studio/T. Schindler). NO_2 column amounts are relative with red colors showing highest values, followed by yellow then blue. OMI NO_2 is a proxy to show local O_3 precursor emission sources.
(b) The bar chart shows a theoretical example of how both domestic anthropogenic and USB O_3 sources combine to produce elevated O_3 at a specific location on any given day. Each source varies daily and there are also nonlinear interactions between USB O_3 sources and domestic anthropogenic sources that can further add to O_3 formation (e.g., forest fires and urban emissions).[5]

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in Figure 2. In each location, a single monitoring site with one of the highest ozone design values in that urban area was chosen. San Bernardino, Atlanta, Boston, Albuquerque, and Sacramento all show statistically significant downward trends in the fourth highest 8-hr ozone concentration whereas the non-coastal western cities, Salt Lake City, Denver, and Reno, plus Chicago show no significant trend since 2000. Overall, the significant reductions in the urban areas are generally consistent with the rural O_3 trends. The downward trends in fourth highest MDA8 O_3 concentrations are linked to significant reductions in emissions of O_3 precursors, while at the same time there can be important regional differences in such precursor emission trends (e.g., emissions related to oil and gas extraction in some parts of the western states) that can help explain some of the weaker trends. Three of the four locations with no significant trend are high elevation sites (Salt Lake City, Denver, and Reno). Trends in O_3 at these western sites might also be influenced by increasing wildfire activity.

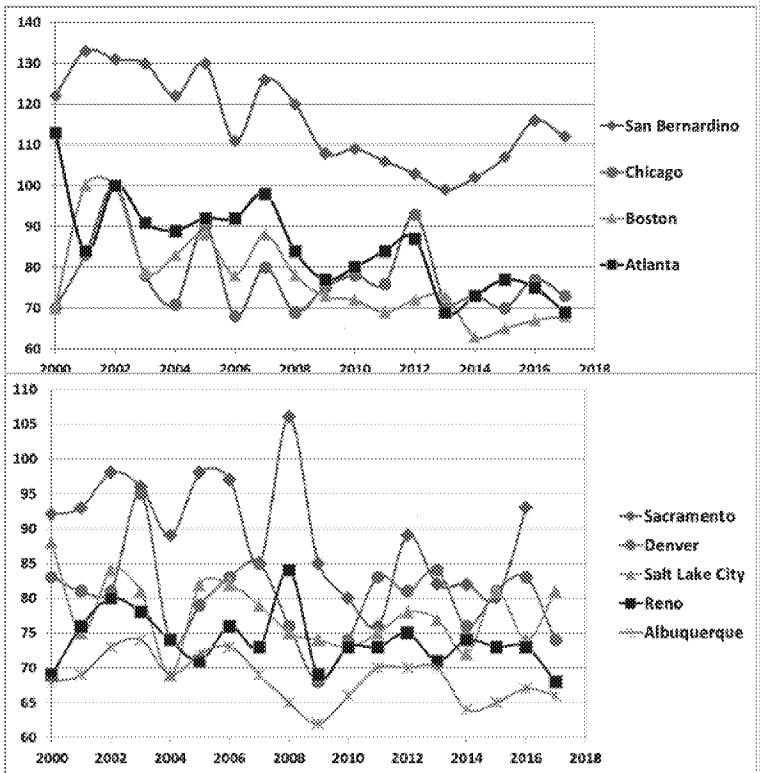

Figure 2. Annual fourth highest MDA8 O_3 (ppb) for one site in each urban area.

Note:
Data shown include any exceptional event days that may have been excluded from the ODV calculation.

Quantification of USB O_3 is essential for air quality management in general, and for state and local efforts to meet the NAAQS, in particular. This is especially true given the recent lowering of the O_3 NAAQS levels and the associated increasing relative importance of USB O3 as domestic precursor emissions decrease. Quantification of USB O_3 requires a chemical transport model (CTM), since it cannot be measured directly, but these models must be informed and evaluated using observations. Most estimates of USB O_3 have been made using regional CTMs such as the Community Multiscale Air Quality Modeling System (CMAQ)[6] and the Comprehensive Air Quality Model with Extensions (CAMx)[7] that are initialized using lateral boundary conditions derived from global models. The model approaches used to estimate USB O_3 have different merits, limitations, and best uses. Different methods of employing CTMs may be best suited (scientifically or computationally) to a specific policy or research question.

USB Ozone Influence on Regional Air Quality Modeling: A Western Case Study

SIPs and FIPs require models to accurately simulate O_3 sources so that the models can be used to examine emission control scenarios to demonstrate future attainment of the NAAQS. Presented here is a case study illustrating results of comparative regulatory applications of the regional modeling platforms. The regulatory analysis excludes identified exceptional days and focuses on the top 10 monitored O_3 days. While this case study compares only two models, it adds to the weight of evidence of the need for further western analyses, as it provides insights into the relationships between regional model estimates of USB O_3 and observations.

The EPA Transport Assessment[8] and the Western Air Quality Study[9] both independently performed model simulations of USB O_3 at 12-km resolution in Colorado for 2011. This is an ideal case study for USB O_3 relevant to state planning because the western states typically have high USB O_3 contributions, and because the Northern Colorado Front Range often experiences high O_3 levels that exceed the NAAQS. The modeling systems in both assessments used global simulations to provide high-time-resolution, varying boundary conditions; EPA used the GEOS-Chem modeling while WAQS used MOZARTv4. USB O_3 contributions were determined as the sum of boundary and natural sources tagged with tracers in the modeling systems, of O_3 from May 1 through Sept. 29. Simulation results were compared for contributions of local, regional, and USB

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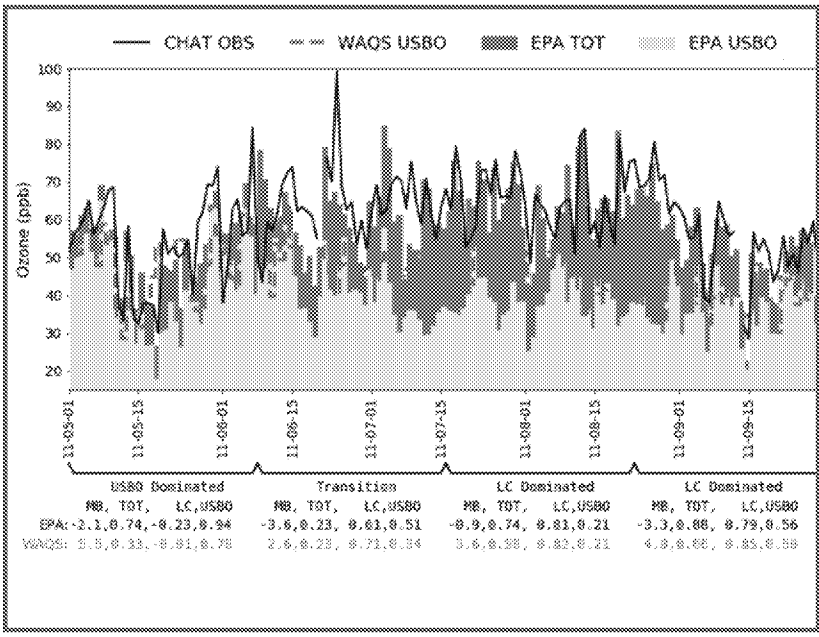

Figure 3. Observed and modeled MDA8 O with USB O from EPA model and WAQS for Chatfield. Observed O_3 (black lines), EPA model MDA8 O_3 (top of dark grey), EPA model USB O_3 (top of light grey), and WAQS USB O_3 (dashed green lines). For four simulation segments, the values below the axis give (for both models) the mean bias (MB), correlation (r) of total prediction with observations (TOT), correlation of local contribution (LC) with observations, and correlation of USB O_3 contribution with observations (USBO). DOI: https://doi.org/10.1525/elementa.309.f6

O_3 sources at a suburban monitor southwest of Denver (Chatfield) and at Rocky Mountain National Park.

EPA and WAQS 2011 modeling for Chatfield and Rocky Mountain National Park highlights similarities between the GEOS-Chem and the MOZARTv4 models, but also confirms the need to improve modeling of USB O_3. Jaffe et al.[10] provide correlations between observations and source contributions at Chatfield over the whole period are generally consistent with previous studies,[11-13] showing that:

1. as illustrated in Figure 1b and Figure 3, USB O_3 and natural/uncontrollable O_3 sources within the United States are significant fractions of total monitored O_3;
2. the monitored and predicted O_3 levels are most strongly correlated with the local contribution; and
3. boundary conditions are anti-correlated with the local contribution of O_3 sources.

Conclusions

Concentrations of O_3 in rural areas of the West originate from a mix of locally controllable and uncontrollable USB sources. Because of this and the fact that, historically, O_3 nonattainment planning policies have focused on resolution of urban O_3 exceedances, a greater emphasis on the identification and quantification of USB O_3 sources is also now necessary for effective regulatory decision-making. While O_3 modeling in the eastern United States has been accomplished through federally-funded efforts under the Ozone Transport Commission, no similar effort with federal funding have ever been initiated in the West. Western states have long commented that EPA should provide funding to help states better understand O_3 background, uncontrollable sources of O_3 precursors and transport in the West.

As a result of the EPA's extraordinary funding support in the East, eastern states have been able to develop a better understanding of the origin of O_3 precursors, O_3 formation, and the fate of O_3 with a level of confidence that helped with the development and implementation of meaningful and effective regulatory programs to improve air quality. The slim differences in the West between the seasonal mean USB O_3 level and the 2015 O_3 NAAQS alone drives a need for increased precision in model accuracy. Western states need detailed O_3 analyses focusing on the western United States to gain a better understanding of the origin of O_3 precursors, photochemical activity, and fate of transported O_3 with a level of confidence that will lead to the development and implementation of effective regulatory programs for the West. **em**

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Author's Note

The authors relied upon the Jaffe, et. al. paper cited next as the primary source for our article under the Creative Commons use policy. We express our sincere gratitude to Dr. Jaffe and his co-authors.

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In Next Month's Issue...

Air Quality Modeling

The U.S. Environmental Protection Agency (EPA) has completed its modeling guideline updates, but new advances in air quality modeling may spur additional changes. The October issue will consider renewed interest in effectively modeling low wind; improved treatment of porous structures and more complex buildings; incorporating scientifically credible, reduced-form chemical mechanisms into dispersion modeling to assess secondary formation; and formulation of next-generation modeling systems for chemical transport models that are driving air quality modeling in new directions.

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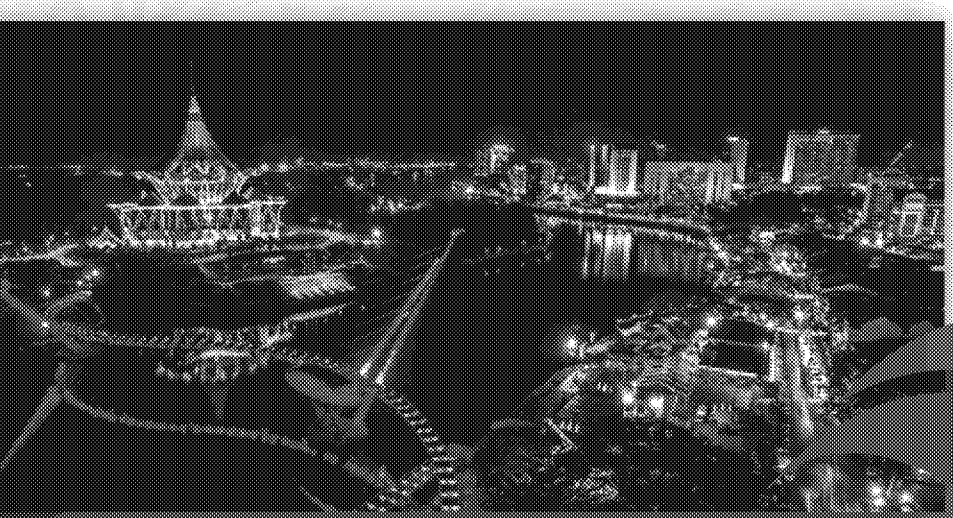

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Minding Business

by David Elam

PM File reminds us to practice mindfulness and avoid the pitfalls of media multitasking.

A day rarely passes without a message about the importance of being mindful. We're encouraged to be mindful in our exercise, our eating, our relationships, and our work. Although there are many ways to practice mindfulness, the consistent theme is that we remain present in the moment, turning our full attention to the activity at hand. It isn't easy to practice mindfulness, and in the project manager's world of changing priorities and deadlines, it can seem impractical. As a result, we tend to turn to "multitasking" in an attempt to work on various tasks simultaneously. Technology has made multitasking seem easy—we can e-mail, talk, instant message, text, search the Web, and write a report all at the same time because we have tools that allow us to do so. But does the fact that we can do something mean that we are doing any of it well?

Research consistently shows that multitasking is ineffective, and in the case of media multitasking—the concurrent consumption of multiple media forms—the process can impair cognitive processes and induce socio-emotional difficulties. Research by Kep Kee Loh and Ryota Kanai, shows that media multitasking reduces gray matter density, resulting in structural brain changes that decrease cognitive control performance and socio-emotional regulation.[1] Effective cognitive processing, responsible social interactions, and emotional intelligence are vital environment, health, and safety (EH&S) project manager attributes that can't be compromised in pursuit of the hollow productivity gains of multitasking. Clearly, multimedia consumption isn't in the best interest of the EH&S project manager.

If we are to preserve the attributes that determine our success as EH&S project managers, we must manage our relationship with technology, recognizing that it exists to serve, not control, us.

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To that end, I invite you to consider the following actions that can help you remain present:

1. **Create a weekly action list.** Take time alone and create a list of tasks that you want to complete for the week. To disconnect from technology, consider creating your list in handwritten form in a notebook. Prioritize the list of tasks based on deadlines and urgency. When you are free from distractions, you will be free to develop an action list that reflects your highest priorities.
2. **Create a daily action list.** Draw from your weekly action list to identify the tasks that you want to or must complete for each given day. I've found most success by creating the list for the next day at the close of the preceding day. Estimate the time for each task, allowing some time each day for unplanned activities. Again, consider creating this list in handwritten form in a notebook, free from technology distractions.
3. **Prepare for every meeting.** You will either chair or participate in several meetings or conference calls during the week. Prepare for each one of them. Whether you are the leader or a participant, consider the guidance offered in a previous column "Meeting Challenges."[2] If you lead the meeting, you are obligated to ensure that it is productive. If you participate in a meeting, you are obligated to contribute productively.
4. **Give your full attention to the task at hand.** When you are in a group meeting, meeting one-on-one with a colleague, or participating in a conference call or Skype meeting, eliminate the distractions of technology by silencing notifications or closing applications. If someone visits you for a discussion, make a point of silencing your phone and closing your e-mail. If the person you are meeting with doesn't take the cue from your actions, politely close the conversation if they allow the meeting to be de-railed by their technology interruptions. If the pressures of a competing deadline keeps you from focusing on the meeting, reschedule the meeting. There is no financial return in making marginal investments in competing interests.
5. **Value the time of others.** We have limited time for interpersonal interaction. Commit to making the most of opportunities that allow it. Plan formal meetings to remain so engaging that no one wants to check their phone for e-mails, texts, or social media posts. And when it comes to social time with friends and family, put them at the forefront, encouraging them to tell their story, a much more interesting proposition than them considering the fleeting posts on their social media network.

Our responsibility as EH&S project managers is to use technology to improve environmental and economic outcomes. We're not likely to achieve those objectives if we are mindless slaves to technology—technology that improperly applied has been shown to reduce our cognitive and socio-emotional skills. Instead, we have the opportunity to be mindful stewards of our responsibilities by setting priorities and following through on those priorities that respect the importance of engagement. **em**

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George R. Offen

(1939–2018)

Emeritus Member, **George R. Offen, Ph.D.**, passed away on August 5, 2018. He was 79.

Dr. Offen was a native of London, UK, having been born there after his parents escaped from Nazi Germany in 1938. The family emigrated to the United States via Uruguay, in a perilous wartime ocean journey, finally settling in San Francisco, CA. As a naturalized U.S. citizen, Dr. Offen attended Stanford University, where he earned bachelor's and doctorate degrees in mechanical engineering. He also earned a master's degree from the Massachusetts Institute of Technology. He was fluent in French and German.

As a senior technical executive at the Electric Power Research Institute in Palo Alto, CA, Dr. Offen's research focused on the reduction of air pollutants from coal-fired power plants, specifically mercury emissions. He and his team also researched low-cost enhancements for particulate (fly ash) controls on difficult-to-collect fly ash, methods to reduce the operational costs and improve the availability of sulfur dioxide controls, and multipollutant controls. Other responsibilities included the development of continuous emission monitors for mercury.

Dr. Offen joined EPRI in 1985 as a project manager, focusing on low-cost sulfur dioxide controls and nitrogen oxides reduction by selective catalytic reduction systems. Before oining EPRI, he was manager of energy engineering at Acurex Corporation. Earlier positions included teaching at Stanford and Santa Clara Universities, research assignments at Chevron Research and the French Institute of Petroleum, and three years as an officer and test engineer with the U.S. Air Force.

Dr. Offen is considered the creator and champion of the highly popular MEGA Symposium series, which is co-hosted by A&WMA. In part as a result of his efforts with the MEGA Symposium, he was awarded the Richard C. Scherr Award of Industrial Environmental Excellence in 2014. The Award is presented annually to an individual who works in the business community, recognizing his/her contributions to the Association and accomplishments in the field of environmental protection.

In his leisure time, Dr. Offen enjoyed hiking, running, and travel. He and his wife traveled extensively,the latest trip to five national parks in Utah.

Dr. Offen is survived by his wife Karen; daughters Catherine and Stephanie; and four grandchildren. **em**

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Getting to Know A&WMA's Organizational Members

On this page you will find the company profiles of a randomly selected grouping of Organizational Members. A&WMA thanks you—and all of our current Organization Members—for your continued support of this Association.

Babst Calland Attorneys at Law

Babst Calland's Environmental Practice Group (www.babstcalland.com) is one of the most respected environmental law practices in the United States. For more than three decades, Babst Calland has been unsurpassed when it comes to addressing new or legacy problems, or anticipating impending regulatory developments or other complications that may be on the horizon.

Babst Calland environmental attorneys provide a nationwide clientele with sophisticated and practical representation in all aspects of environmental law. With the nation's largest staff of regulatory attorneys who focus their practices exclusively in this field, our environmental attorneys are able to focus their practices on specific environmental areas, such as air pollution, industrial and municipal wastewater management, hazardous and solid waste, complex site remediation, natural resource damages, chemical regulation, and occupational safety and health.

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In addition to extensive experience, Babst Calland also offers a very competitive rate structure. With environmental attorneys with varying levels of environmental experience from one year to more than 40 years, Babst Calland can perform work at the most cost-efficient level.

Through an integrated, multidisciplinary approach and preventative law philosophy, Babst Calland environmental attorneys collaborate with attorneys in the firm's other legal practices, including construction, corporate and commercial, creditors' rights and insolvency, employment and labor, energy and natural resources, land use, litigation, public sector, real estate, and ransportation safety. This collaboration creates a synergy not typically found in today's legal market and enables us to comprehensively advise our clients, by taking into account relevant legal considerations from multiple disciplines.

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Cornerstone Environmental (www.cornerstoneeg.com), a Tetra Tech Company, is an engineering consulting and field service firm dedicated to providing services to the solid waste industry and commercial, industrial, and agricultural clients throughout the United States. Cornerstone provides a range of specialized services spanning multiple markets, including Air Quality, Biogas & Landfill Gas, Environmental Planning and Compliance, Hydrogeology, Landfill Engineering & Design, O & M, Organics Management, Remediation, Site & Civil Design, and Transfer, Recycling, and Processing Facilities.

Cornerstone's air quality services practice includes a diverse mix of mechanical, chemical, civil, and environmental engineers, working alongside air pollution scientists with a depth of experience in all areas of air quality services, including New Source Review and Title V Air Permitting, atmospheric dispersion modeling, NSPS & NESHAP permit compliance support, compliance assessments and emission source inventories, ambient air monitoring and monitoring plan development, point source emissions testing review and oversight, community awareness and public relations support, mobile data collection and mapping, and spatial information management. Many of Cornerstone's air quality personnel have both consulting and regulatory experience. The firm's approach includes extensive hands-on experience in examining production processes from the perspective of emissions and regulatory compliance.

To advance the state-of-practice and provide forward-looking sustainable projects, Cornerstone implements new technology and reaches for the next innovation. For example, the company developed BioCNG (www.biocng.us), an alternative vehicle fuel system that uses a patented biogas conditioning system to economically produce biogas-based fuel to power compressed natural gas vehicles. BioCNG uses biogas from organic and agricultural digesters, landfills, and wastewater treatment plants to produce renewable fuel.

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For more than a century, the business law firm of **Bingham Greenebaum Doll (BGD) LLP** (www.bgdlegal.com) has provided environmental legal services to clients across a wide array of industries and sectors. Clients served include manufacturers, public and private utilities, energy and mining businesses, real estate developers, financial institutions, and agribusinesses. BGD's attorneys use their industry knowledge and understanding of federal and state regulatory programs to provide innovative solutions to complex issues and, if necessary, are able to draw on a broad experience in environmental litigation.

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