Many U.S. counties would be in violation of the proposed new ozone NAAQS.
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Making a Case for Face-to-Face Conferencing

by Dallas Baker, P.E., BCEE
president@awma.org

Why do we conference together? In this age of smart phones, webinars, Skype, Google, and social media, we have immediate access to people and information our parents could only have dreamed about. From the comfort and convenience of our home or office, these media allow us to easily exchange ideas, data, opinion, and even solutions with ease and efficiency. A&WMA’s 108th Annual Conference & Exhibition is just over a month away, with early bird registration ending on May 21, so why take the time to register, pack a bag, and travel out of town for a week-long technical conference? Published author and blogger Phil Gerbyshak offers five reasons to attend conferences; I’ll present my spin on each.

Networking. I’ve conversed with thousands of people by phone and e-mail throughout my career, but it’s those I’ve met in person I remember the most. Putting a face to a name and a handshake to a greeting is how true business relationships begin. Having a personal, in-depth conversation with a new colleague can develop a long relationship in the right direction. Being inspired helps us to think about why something is important will allow me to make better decisions and ensure I’m heading in the right direction. Being inspired helps us perform at a higher level.

Inspiration. This year’s keynote session will be headlined by Gina McCarthy, U.S. Environmental Protection Agency (EPA) Administrator. Hearing what she and others holding different viewpoints think about why something is important will allow me to make better decisions and ensure I’m heading in the right direction. Being inspired helps us perform at a higher level.

Interaction. Our Sponsors and Exhibitors will be on hand to demonstrate the innovative products and services they provide and to assist you in making wise science and engineering choices. With over 100 exhibitors, the Exhibit Hall is a great place to learn what’s new in our industry.

Knowledge Sharing. Being a member of A&WMA gives you an opportunity to tell your peers what work you do. The Annual Conference is where professional accomplishments are recognized and celebrated, and where you can gain exposure in your particular work area.

Visit http://ace2015.awma.org to register and to review the schedule of events that have been organized to deliver the highest conference value. As you will discover, this year’s program is filled with presentations, analysis, and discussion of the hot topics from the leading experts and policy-makers in our field. One such topic is the subject of this issue of EM: EPA’s proposed changes to the 2008 National Ambient Air Quality Standards for ground-level ozone. Hosting the Annual Conference in the Research Triangle Park area—the largest concentration of air policy development and research in the world—A&WMA brings top-level leaders within EPA together with other regulators and regulated industry representatives to discuss how these changing rules impact future strategies of compliance and air quality attainment.

My hope is that you are busy making plans to visit North Carolina June 22–25 and bringing with you an enthusiasm and desire to exchange knowledge and information with your peers. See you there! em
358 counties would exceed 70 parts per billion (ppb)
200 additional counties would exceed 65 ppb

A summary of the development of EPA’s proposed tightening of the 2008 National Ambient Air Quality Standards (NAAQS) for ozone, and representative stakeholder viewpoints.

In December 2014, the U.S. Environmental Protection Agency (EPA) proposed to tighten the 8-hr 2008 National Ambient Air Quality Standards (NAAQS) for ozone (O₃) from 75 parts per billion (ppb) to a level within a range of 65–70 ppb.¹ In this issue of EM, we collect articles from a range of participants in the ongoing NAAQS review process, including EPA, the chair of the Clean Air Scientific Advisory Committee (CASAC), a consultant to the American Lung Association (ALA), state environmental agencies from Maryland and Texas, the American Petroleum Institute (API), and the law firm Hunton and Williams.

The first two articles describe the process EPA and CASAC followed in assessing the science and developing the proposal. EPA’s Karen Wesson and Erika Sasser discuss considerations supporting the proposed health- and welfare-based standards, note proposed changes to the air quality index (AQI), and present the schedule for finalizing the standards and designating non-attainment areas. In addition to summarizing CASAC’s role in the process, Chairman Christopher Frey reviews the CASAC’s conclusions and recommendations to the EPA Administrator on the standards.

The remaining articles provide a range of perspectives from key stakeholder groups, generally focusing on the health-based standard. ALA consultant Deborah Shprentz argues that the science provides strong support for an O₃ standard even lower than EPA’s proposed range. Maryland’s Tad Aburn and coauthors believe an updated O₃ standard is appropriate and achievable, but focus more on implementation issues, particularly the importance of cooperative efforts that continue to reduce regional sources of O₃ complemented by smart local efforts that target each area’s unique local contribution to the problem.

Bryan Shaw, Sabine Lange, and Michael Honeycutt of Texas believe that a thoughtful integration of the scientific data does not support EPA’s assertion that lowering the standard to 65–70 ppb would result in measurable health benefits, summarizing their own assessment of some of the key scientific evidence. Howard Feldman of API argues that the current scientific evidence does not support EPA’s conclusion that revising the present standards is necessary to protect the public health and welfare. He notes that the decline in O₃ prompted by current programs continue under the current standards without the additional high costs and limits to growth in new non-attainment areas. Finally, Lucinda Minton Langworthy and Aaron Flynn of Hunton and Williams also question EPA’s interpretation of the human clinical and epidemiologic studies, as well as the welfare effects evidence supporting the proposal. They state that unnecessary revisions would disrupt implementation of the 2008 O₃ NAAQS and raise a number of difficult issues regarding tighter standards.

We note that EPA, as well as Langworthy and Flynn, highlight that standards in the proposed range are approaching “background” levels measured in remote areas. Because the O₃ background is related to both natural and anthropogenic sources, including international transport, this raises implementation issues invoking difficult-to-address “exceptional events” and international air pollution concerns. As will be discussed in next month’s summary of the 2015 Annual A&WMA Critical Review, a substantial fraction of globally transported O₃ is derived from methane emissions heretofore excluded from regulation as an O₃ precursor. As Aburn et al. note, interstate transport will continue to be an important issue. Tightened standards resulting in more non-attainment areas could lead to a new emphasis on states working individually, together or under new EPA regulations to address interstate transport.

Tighter standards also might pose issues for EPA’s proposed Clean Power Plan (CPP), which, in order to reduce power sector carbon dioxide emissions, envisions substantial actions by utilities...
and states to construct and permit numerous new natural gas-based generating units and infrastructure projects (e.g., natural gas pipelines, new transmission lines) to ensure adequate supplies of natural gas are available to new and existing units and to support intermittent renewable energy generation. U.S. Clean Air Act permitting requirements in O₃ non-attainment areas could pose challenges.

The range of forecast non-attainment varies based on the standards level and timing. EPA estimates that the proposed standards would lead to between 358 and 558 counties with monitors not meeting the standards based on 2011–2013 data. EPA would add more counties without monitors when it completes non-attainment designations in late 2017, but those designations would be based on 2014–2016 monitoring data. EPA modeling projects that many of these counties would attain the standards by 2025 due, in part, to existing regulations. We hope that it is true, but note that the projections are uncertain.

Finally, in assessing potential costs and benefits of alternative new standards, EPA found that benefits exceeded costs over the proposed range of levels, but was unable to fully document strategies to achieve new standards. EPA had to assume adoption of 750 and 150 thousand tons of *unknown* nitrogen oxides (NOₓ) controls for the 65- and 70-ppb standards, respectively, in the Eastern United States, creating a significant uncertainty. As noted above, implementation challenges will depend in great measure on the final level of the standards.

References
1. 79 Fed. Reg. at 75,234.
Vision for the future.

At Duke Energy, we’re generating a new source of energy. It's called vision. And it requires innovation and foresight – the fuels of our future.

Our vision is only the beginning. Cleaner, more reliable and affordable energy will ensure our children and grandchildren can lead healthy and productive lives.
EPA’s Review of the Current NAAQS for Ozone

by Karen Wesson and Erika Sasser

Karen Wesson and Erika Sasser are both with the U.S. Environmental Protection Agency, Office of Air and Radiation, Health and Environmental Impacts Division.

On November 25, 2014, the U.S. Environmental Protection Agency (EPA) proposed to strengthen the National Ambient Air Quality Standards (NAAQS) for ground-level ozone. This proposed decision was based on extensive scientific evidence, including more than 1,000 new studies since the last review, showing that ozone can cause a number of harmful effects on human health and the environment. The proposed updates will improve public health protection, particularly for children, the elderly, and people of all ages who have lung diseases, and will improve protection for trees, plants, and ecosystems.
Ozone, a key component of smog, is formed by photochemical reactions of precursor gases and is not directly emitted from specific sources. In the stratosphere, ozone occurs naturally and provides protection against harmful solar ultraviolet radiation. In the troposphere, near ground level, ozone forms through atmospheric reactions involving two main classes of precursor pollutants: volatile organic compounds (VOCs) and nitrogen oxides (NOx). These pollutants are emitted from anthropogenic sources (e.g., cars, trucks, buses, industries, power plants), products (e.g., solvents and paints), and natural sources (e.g., vegetation, biomass burning, and lightning).

Exposure to ozone can cause respiratory system effects, such as difficulty breathing and airway inflammation. For people with lung diseases such as asthma and COPD (chronic obstructive pulmonary disease), these effects can lead to emergency room visits and hospital admissions. Studies have also found that ozone exposure is likely to cause premature death from lung or heart diseases. People most at risk from breathing air containing ozone include children; people with asthma and other respiratory diseases; older adults; and people who are active outdoors, especially outdoor workers. An estimated 25.9 million people in the United States have asthma, including almost 7.1 million children.

Scientific evidence also shows that repeated exposure to ozone has harmful effects on plants and trees. These effects include visible injury to leaves, decreased photosynthesis, reduced vegetation growth, and reduced yield and quality of agricultural crops. Exposure to ozone can affect carbon storage, water cycling and nutrient cycling, and can alter terrestrial community composition. These types of effects have the potential to impact ecosystems and the benefits they provide.

The U.S. Clean Air Act (CAA) requires EPA to set two types of NAAQS: primary standards to protect public health with an “adequate margin of safety,” including the health of at-risk groups; and secondary standards to protect public welfare “from any known or anticipated adverse effects” (e.g., impacts on soils, water, crops, vegetation, man-made materials, weather, visibility, and climate). EPA is required to periodically review the standards and the science upon which they are based.

**NAAQS Review Process**

Reviewing NAAQS is a comprehensive undertaking and includes the major phases shown in Figure 1. Before reaching the proposed and final notice phases, EPA develops a series of documents that inform EPA’s decision-making. Scientific review during the development of these documents is thorough and extensive. Drafts of all documents are reviewed by EPA’s independent scientific review committee, the Clean Air Scientific Advisory Committee (CASAC; see article by H. Christopher Frey on page 9), and made available for public comments. Final documents are developed with consideration of CASAC advice and public comments.

At the beginning of the NAAQS review process, EPA holds a science policy workshop to gather input from the scientific community and the public regarding policy-relevant issues and questions that will frame the review. Drawing from the workshop, EPA then prepares an Integrated Review Plan (IRP).
that presents the schedule for the entire review, the process for conducting the review, and the key policy-relevant science issues that will guide the review. Following the IRP, the Integrated Science Assessment (ISA) presents a comprehensive review, synthesis, and evaluation of the most policy-relevant science. Drawing from the information and conclusions in the ISA, the Risk and Exposure Assessment (REA) develops quantitative characterizations of exposures and associated risks to human health or the environment, with a focus on the exposures and risks associated with air quality that is estimated to just meet the current standard(s), as well as any potential alternative standard(s) under consideration.

Next, to bridge the gap between the scientific assessments presented in the ISA and REA(s) and the judgments required of the EPA Administrator in determining whether it is appropriate to retain or revise the NAAQS, a Policy Assessment (PA) is developed to provide a staff analysis of the scientific basis for policy options for consideration by senior EPA management. In providing this analysis, which undergoes CASAC review, the PA is intended to facilitate CASAC’s advice to the agency and recommendations to the Administrator, as provided for in the CAA, on the adequacy of the existing standards or revisions that may be appropriate to consider.

For the current ozone NAAQS review, the draft and final versions of each of these documents can be found on EPA’s Web site, along with links to the associated CASAC reviews. Taking into consideration information from these documents, including the scientific information about ozone exposure and health and welfare effects, air quality information, quantitative risk information, the uncertainties and limitations of the scientific evidence and quantitative analyses, and the conclusions of EPA staff experts, as well as advice from the CASAC and public comments, the Administrator proposed revisions to both the current primary...
The Clean Air Scientific Advisory Committee (CASAC) provides independent advice to the EPA Administrator on the technical basis of the National Ambient Air Quality Standards (NAAQS). Section 109(d)(2) of the U.S. Clean Air Act (CAA) requires that an independent scientific review committee periodically review both the scientific criteria and the NAAQS and “recommend to the Administrator any new… standards and revisions of existing criteria and standards as may be appropriate.” Under CAA Section 108, these standards must “accurately reflect the latest scientific knowledge.” The CASAC is composed of seven members appointed by the EPA Administrator, but each NAAQS review is augmented with additional experts. The CASAC and panel include experts in health effects, ecological effects, air quality and risk assessment methods. The current Ozone Review Panel is composed of the seven CASAC members and 13 additional experts.

The NAAQS ozone review process was lengthy and multifaceted (see EPA Figure 1 on page 8) with significant CASAC involvement. CASAC’s review of the ozone criteria and standards spanned nearly five years, from 2009 to 2014, including numerous public meetings and delivery of 10 reports to the EPA Administrator. CASAC provided consultation on EPA’s Integrated Review Plan for how it would develop the Integrated Science Assessment (ISA) (Samet, 2011; EPA, 2011a). CASAC conducted extensive reviews of the ISA, health and public welfare REAs, and Policy Assessment (PA) (EPA, 2013, 2014a,b,c). CASAC conducted extensive reviews of the ISA, health and public welfare REAs, and Policy Assessment (PA) (EPA, 2013, 2014a,b,c).

In reviewing each assessment, CASAC held a public meeting announced in the Federal Register, during which there was opportunity for public comment. CASAC provided detailed review and advice to the Administrator regarding the first draft of the ISA (Samet, 2011b) and requested substantial revisions. Upon reviewing the second draft of the ISA in March 2012, CASAC requested a third draft (Samet, 2012). In November 2012, CASAC advised the Administrator that, with some revision, the third draft of the ISA “will serve as a scientifically sound foundation” for the remaining steps of the ozone NAAQS review process (Frey and Samet, 2012a). At that time, CASAC advised the Administrator that the first drafts of the REAs for human health and public welfare were “works in progress” in need of significant revision (Frey and Samet, 2012b), and that the first draft PA “needs substantial improvement” (Frey and Samet, 2012c).

In a series of letters to the Administrator in 2014, CASAC provided detailed review of the second drafts of the REAs for health and public

by H. Christopher Frey

H. Christopher Frey is Distinguished University Professor at North Carolina State University and Chair of EPA’s Clean Air Scientific Advisory Committee (CASAC).
and secondary ozone standards. For reference, the current (2008) primary and secondary ozone standards are set at a level of 0.075 parts per million (ppm; or 75 parts per billion [ppb]), measured as the annual fourth-highest daily maximum 8-hr concentration, averaged over three years.

**Current Standard Not Requisite to Protect Health**

For the primary health-based standard, the Administrator proposed that the current primary ozone standard is not requisite to protect public health, including at-risk groups, with an adequate margin of safety. The Administrator proposed to retain the current averaging time and form of the standard (annual fourth-highest daily maximum 8-hr concentration, averaged over three years), but to revise the level within the range of 65 to 70 ppb. Recognizing that the CASAC recommended a range of levels from 60 to 70 ppb, the Administrator solicited comment on alternative standard levels below 65 ppb and as low as 60 ppb.

CASAC also provided advice on revising the ozone NAAQS for public welfare effects. CASAC identified key types of damage to ecosystems from exposure to ozone, including “adverse welfare effects related to ecosystem services, food and fiber products from crops, and damage to resource use from foliar injury.” CASAC recommended that EPA adopt a new “biologically-relevant” form (known as “W126”) for estimating ecosystem exposure to ozone based on a typical plant growing season. The W126 form has units of parts per million (ppm) multiplied by time. CASAC recommended “that the level associated with this form be within the range of 7 ppm-hrs to 15 ppm-hrs.” CASAC favored a single-year period, based on the highest 3-month W126 value during the year, for determining the W126 value “to provide more protection for annual crops” and to protect against “cumulative effects on perennial species.” CASAC also communicated recommendations to the Administrator regarding research needs, international transport of ozone, a process for assessing adverse and beneficial impacts of standard implementation, and multipollutant approaches to air quality management.

**Disclaimer**

These are Dr. Frey’s personal views, and they do not represent any official position of the U.S. Environmental Protection Agency (EPA) or the EPA Clean Air Scientific Advisory Committee (CASAC).

*Editor’s Note:* The documents cited in this article can be found in the online version at [http://digitaladmin.bnpmedia.com/publication?i=252949](http://digitaladmin.bnpmedia.com/publication?i=252949)

Simply navigate to this feature, then click on the headline to download the text file.
Green Energy Solutions.
EPA projects that peak ozone levels will continue to improve over the next decade as additional reductions in ozone-forming pollutants are realized.

60 ppb, but noted the increasing uncertainty in the scientific evidence at lower ozone concentrations. This uncertainty reduces confidence that ozone standard levels below 65 ppb will result in additional health improvements, compared to those that would result from a standard in the proposed range of 65 to 70 ppb. In addition, given the alternative views of the currently available evidence and information expressed by some commenters, the agency also accepted comment on all aspects of the proposal, including retaining the existing standard.

**Proposed AQI Updates**

The proposal included proposed updates to the Air Quality Index (AQI). The AQI is EPA’s color-coded tool for communicating to the public about how clean or unhealthy the air is, and what associated health effects might be a concern. These updates include revisions to the AQI breakpoints that delineate the various AQI categories (e.g., good, moderate, unhealthy for sensitive groups, unhealthy, very unhealthy, and hazardous) and draw directly from the underlying health information that supports the proposed changes to the ozone primary standard.

**Current Standard Not Requisite to Protect Public Welfare**

For the secondary welfare-based standard, the Administrator proposed that the current secondary standard is not requisite to protect the public welfare from any known or anticipated effects. EPA proposed that the secondary standard be revised to provide increased protection against the cumulative exposures that can damage plants and trees during the growing season, when daytime ozone concentrations are the highest and plant growth is most affected. The agency proposed that ozone air quality of 13 to 17 parts per million-hours (ppm-hrs), in terms of a W126 index\(^4\) averaged across three years, would provide the requisite protection against adverse effects to the public welfare.

To achieve this level of protection, EPA proposed that it is appropriate to retain the existing averaging time and form of the standard, and revise the level to within the range of 65 to 70 ppb. EPA air quality analyses found that revision of the level of the secondary standard to within this range would provide air quality, in terms of three-year average W126 index values, at or below a range of 13 to 17 ppm-hrs.

In recognition of CASAC’s recommendation with regard to a distinct secondary standard, the Administrator solicited comment on revising the form and averaging time of the secondary standard to be based on the W126 metric, averaged across three years and with a level within the range of 13 to 17 ppm-hrs, and also solicited comment on a level within the range extending below 13 ppm-hrs down to 7 ppm-hrs. Further, given the alternative views of the currently available evidence and information expressed by some commenters, the Administrator also solicited comment on retaining the current standard.

EPA provided a 90-day comment period after the proposal was published in the *Federal Register* that ended on March 17, 2015. EPA held three public hearings in Washington, DC; Arlington, TX; and Sacramento, CA, in late January and early February. The agency is currently considering comments received on the proposed rule and will issue a final decision by October 1, 2015. As required by the CAA, EPA would make attainment/nonattainment designations for any revised ozone standard by October 2017. Those designations likely would be based on 2014–2016 air quality data.

**Protecting Air Quality Is a Federal/State/Tribal Partnership**

EPA has a long history of working closely with states as they develop State Implementation Plans (SIPs) to reduce emissions of ozone precursors within individual jurisdictions. The agency plans to propose rules and guidance to assist areas with implementing revised standards, and will work with states that may need to address relatively infrequent events when ozone formed from sources such as wildfires or stratospheric intrusions contributes to ozone exceedances. For example, EPA plans to update its Exceptional Events Rule, which outlines the requirements for excluding air quality data (including ozone data) from regulatory decisions if the data are affected by an exceptional event. The Exceptional Events Rule is one of
several tools available to states as they develop their clean air plans for addressing natural events that may contribute to ozone or ozone precursors. In addition, EPA is developing guidance to address Exceptional Events Rule criteria for wildfires that could affect ozone concentrations.

Protecting air quality is a federal/state/tribal partnership, and EPA, states and tribes have made significant progress reducing ozone. Nationwide, ozone levels have dropped by a third since 1980 at monitor sites that track ozone trends, with ozone levels having declined 18% from 2000 to 2013. In addition, EPA projects that peak ozone levels will continue to improve over the next decade as additional reductions in ozone-forming pollutants are realized, and that the vast majority of U.S. counties with monitors would meet the proposed standards by 2025 just with the rules and programs now in place or under way. These rules include the final Mercury and Air Toxics Standards, requirements to reduce the interstate transport of air pollution, Regional Haze regulations, the proposed Clean Power Plan, and the final Tier 3 Vehicle Emissions and Fuels Standards. EPA estimates that meeting the proposed ozone standards will yield significant health benefits across the United States, including avoided asthma attacks, heart attacks, missed school and work days, as well as premature deaths.5

References
1. The notice of proposed rulemaking was published in the Federal Register on December 17, 2014, and can be found at http://www.gpo.gov/fdsys/pkg/FR-2014-12-17/pdf/2014-28674.pdf.
2. See http://www.epa.gov/ttn/naaqs/standards/ozone/s_o3_index.html.
4. A W126 index is a weighted index, calculated as the three consecutive month period within the ozone season with the maximum index value, with daily exposures cumulated for the 12-hr period from 8:00 a.m. to 8:00 p.m. For more details on the calculation, see http://www.epa.gov/ttn/analysis/w126.htm.
Deborah Shprentz is consultant to the American Lung Association.

The American Lung Association and other leading medical organizations are calling for EPA to set a stricter standard for 8-hr ozone.

Ozone is one of the most pervasive and pernicious of the common air pollutants. Ozone is a powerful oxidant, so powerful that it is used to treat and disinfect drinking water supplies. At ambient concentrations, ozone has been shown to cause a variety of harms, including damaging forests and crops and endangering human health.

Ozone enters the human body via the lungs, and that is where the most damage occurs. Respiratory harms range from impeding inspiration to causing inflammation, coughing, and increased susceptibility to colds and flu. Ozone exacerbates asthma, leading to increased reliance on medication and increased visits to hospital emergency departments. There is now strong evidence that ozone increases the risk of premature death.

The long-term effects of ozone are also well documented. When infant monkeys are exposed to high concentrations of ozone, their lung development is
stunted.5 Similarly, children growing up in more polluted areas never develop the lung capacity of their peers raised in less polluted environments.6

Advances in biostatistics have enabled epidemiologists to tease out the effects of ozone from that of other air pollutants and confounding factors. We now know that ozone contributes to a range of public health harms, including respiratory and cardiac effects, and even premature death, at concentrations well below the current standards.7

The U.S. Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) that protect the public health, including the health of sensitive populations, with an adequate margin of safety.8 The CAA requires EPA to review the standards every five years, in light of advancements in the science, to ensure that the standards are health-protective.

The U.S. Supreme Court has affirmed in a unanimous decision that the NAAQS must be based solely on health protection.9 Economic factors are taken into account when developing implementation strategies.

The fact that the current standard is not protective of public health is well established, and has been for many years. Since 2006, the Clean Air Scientific Advisory Committee (CASAC), the independent panel of experts advising EPA, has repeatedly urged that EPA set an 8-hr average ozone standard within the range of 60 to 70 parts per billion (ppb). This has been the unanimous conclusion of three separate CASAC panels under three different Chairpersons for the past nine years.10

**The Scientific Evidence Is Strong**

The evidence base for ozone is stronger than for any other air pollutant. There are strong lines of evidence from all three major scientific disciplines: toxicology, epidemiology, and controlled human exposure studies.

The current review is premised on a comprehensive evaluation of the science completed in 2013. Based upon the substantial new information available, the 2013 Integrated Science Assessment (ISA) reached much stronger conclusions about the health effects of ozone than had been reached in the prior review.11 The criteria for evaluating studies and reaching causal determinations is carefully laid out in the ISA, and were thoroughly vetted by the CASAC.12 Conclusions are reached based on multiple lines of evidence and multiple studies, demonstrating coherence, consistency, and plausibility.

Specifically, the 2013 ISA:

- concludes that ozone causes adverse respiratory effects;
- evaluates several additional controlled human exposure studies demonstrating respiratory deficits and inflammation in healthy young adults at 60 ppb;
- makes stronger findings that the adverse effect of ozone on cardiovascular health are likely causal;
- reviews new information suggesting reproductive effects, such as increased risk of low birth weight babies;
- reaches new conclusions about suggestive neurological effects;
- reaffirms based on new community health studies strengthening the link between ozone exposure and mortality, even at concentrations below the current standards; and
- identifies new information about the impact of longer-term exposures on respiratory health endpoint, such as pulmonary inflammation and injury, and new onset asthma.

The 2013 ISA found there was a causal relationship between short-term exposure to ozone and respiratory effects.12 For almost every other health outcome and exposure duration evaluated, the ISA reached stronger causal determinations in 2013 than in the review completed in 2008.12

There is considerably more certainty for several critical health endpoints than in the prior review, compelling more stringent air quality standards. Under the CAA, EPA is obliged to set air quality standards that protect public health from proven, as well as anticipated health effects.13 Revisions to
the standards must reflect the increased strength of the evidence, and the breadth of adverse health effects now attributable to ozone air pollution.

For a number of important respiratory health endpoints, including lung function decrements, inflammation, hospital and emergency department visits for respiratory causes, the ISA indicates adverse effects at 60 ppb.¹⁴ This provides strong support for a standard no higher than 60 ppb.

Several controlled human exposure studies of healthy young adults have demonstrated a reduction in lung function and an increase in inflammation at 6.6-hr exposures of 60 ppb.¹⁵ Some individuals respond more severely than the group average.¹⁶ Inflammation of the lining of the lungs is a serious health concern.¹⁷ Lung function declines especially of concern to children and adults with asthma and chronic obstructive pulmonary disease (COPD), because these individuals have reduced pulmonary reserves.¹⁸

Because healthy adults are harmed after 6.6-hr exposures of 60 ppb, the 8-hr standards must be set lower to protect sensitive populations—such as children, children with asthma, and people who work or exercise outdoors—with an adequate margin of safety.¹⁹

Community health studies in Europe and North America have demonstrated consistent, positive associations between ozone air pollution and hospital admissions and emergency department visits for respiratory causes.²⁰ Generally, mean 8-hr maximum ozone concentrations were less than 60 ppb.²¹

Consistent associations between ozone and respiratory mortality have been reported in single-city and multi-city studies. The mean 8-hr maximum ozone concentration in these studies is less than 63 ppb.²² Even when days above 60 ppb are excluded from the analysis, the effect of ozone on mortality is still evident.²³

Longer-term studies have also demonstrated the need for a stricter standard to protect against chronic effects. There is increased evidence that chronic exposure to ozone may increase the risk of new onset asthma, at mean annual 8-hr maximum concentrations of 55.2 ppb.²⁴ Active children living in more polluted areas run a greater risk of developing asthma.²⁵ Studies with mean annual 8-hr maximum ozone concentrations less than 41 ppb have found that chronic ozone exposures puts kids with asthma at greater risk of a hospital admission.²⁶

Sensitive Populations Must Be Protected

Several populations are particularly vulnerable to the effects of ozone air pollution. These groups include children, the elderly, and people with respiratory conditions such as asthma. In addition, people who work or exercise outdoors are at increased risk due to their increased exposure to ozone.²⁷ There is growing information on obesity as a potential risk factor for increased susceptibility to ozone air pollution.²⁸ Two-thirds of the U.S. population is classified as overweight or obese, including a growing number of children and adolescents.²⁹ Obese individuals have higher breathing rates, which can increase their exposure to ozone and other air pollutants.³⁰

Under the CAA, the NAAQS must protect these sensitive populations with an adequate margin of safety.³¹ It follows that standards must be set below the levels shown to cause harm in healthy test subjects.

CASAC Recommends Standard in 60–70 ppb Range

In a recent letter to the EPA Administrator,³² CASAC made clear that:

• the current standard is inadequate to protect public health;
• at 70 ppb, there is substantial evidence of adverse effects, including decrease in lung function, increase in respiratory symptoms, and increase in airway inflammation;
• a standard of 70 ppb provides little margin of safety and advised that the standard should be set below this level to meet the statutory requirement in the Clean Air Act to protect public health with an adequate margin of safety; and

There is now strong evidence that ozone increases the risk of premature death.
• 60 ppb is the most protective option, and the only option that would “certainly” provide an adequate margin of safety.

The American Lung Association and other leading medical organizations, including the American Academy of Pediatrics, American Thoracic Society, American Medical Association, American College of Chest Physicians, American College of Preventive Medicine, American College of Occupational and Environmental Medicine, American Association of Cardiovascular and Pulmonary Rehabilitation and National Association for the Medical Direction of Respiratory Care support an 8-hr average standard of 60 ppb or below, based on strong evidence from the controlled human exposure studies and the epidemiological studies.33

References
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Maryland has struggled with ozone non-attainment for over 30 years. We’ve seen success, we’ve seen some setbacks, and we’ve learned a lot. There are many current issues linked to ground-level ozone being discussed across the nation. The top six policy-relevant conclusions from our 30-year struggle are:

1. We understand the fundamental, policy-relevant science of ozone production in the East, and believe that continuing significant progress can be achieved.
2. An updated ozone standard is appropriate and achievable.
3. An enhanced partnership with the U.S. Environmental Protection Agency (EPA) will be essential for making continued progress with ozone because the regional contribution to ozone in almost all areas is now dominant and

The Maryland Department of Environment partners with the University of Maryland at College Park, NASA, and other researchers to study how meteorology, photochemistry, and geography conspire to make the ozone problem so challenging.
is predicted to become more so as the standards tighten.
4. Stronger partnerships between state and local governments and stakeholders will also be critical.
5. The private sector and environmental advocates can make a major contribution to insuring environmental and economic progress by being strategic about litigation.
6. International transport is becoming an important issue, but not one that should be used to delay continuing progress.

Background
For more than 30 years, Maryland has struggled with meeting the federal ozone standard. During that period, the Maryland Department of Environment (MDE) has partnered with the University of Maryland at College Park, NASA, and other researchers to study how meteorology, photochemistry, and geography conspire to make the ozone problem in the Mid-Atlantic so challenging. Processes on both the local and regional scale influence ozone formation and transport.¹⁻¹⁰

This research has played a significant role in the progress we have made in reducing exposure to ozone (and other pollutants) and provides a clear path forward for continuing to reduce ozone levels in the eastern half of the United States. Ozone issues west of the Mississippi appear to have some similarities to those in the East, but there are also some significant differences in meteorology and geography that create different challenges. This article focuses on ozone in the East, an area of lush forests where field experiments and numerical models have shown that nitrogen oxide (NOₓ) emissions combined with biogenic hydrocarbons are sufficient to generate ozone events.¹¹⁻¹⁴

After struggling with making progress with ozone in the 1970s, 1980s, and 1990s, ozone levels in Maryland, like the rest of the East, dropped dramatically over the past 10 years (see Figure 1 on page 20). Why?

From Maryland’s perspective two major shifts in eastern ozone policy drove this change:

1. An increased focus on NOₓ reductions; and
2. An increased focus on significant regional reductions of NOₓ across the East from mobile sources, electric generating units (EGUs), and other large emission sectors.

The classic 1990 report from the National Academy of Sciences foreshadowed the importance of these issues: the data show they were right.¹⁵

Local emission reduction programs have helped and will continue to help reduce ozone, but the large-scale regional NOₓ reduction programs are what drove the noticeable improvements in ozone seen starting around 2003. Why?

Where Does Ozone in the Mid-Atlantic States Come From?
Ozone in the Mid-Atlantic is complicated. This issue can be understood by examining the two primary pieces of the problem: regional transport (i.e., ozone and ozone precursors from upwind sources across a large portion of the East) and local sources. In general terms, on bad ozone days in Baltimore, MD, approximately 70% of the problem is regional transport and approximately 30% is local.¹⁶ As part of our research efforts, we measure “incoming” ozone levels with ozonesondes and airplanes that routinely approach or exceed the current 75 parts per billion (ppb) ozone standard.¹⁷⁻²⁰

The regional transport component of our problem, builds up and collects in an “elevated reservoir” of ozone and ozone precursors that exists about...
1,000 m above the Mid-Atlantic and much of the East from May to September.\textsuperscript{21,22} Ozone levels in the elevated reservoir can routinely be 70 ppb or greater on episode days.\textsuperscript{23}

The influence of the elevated reservoir can best be seen by analyzing the morning “surge” of ozone reported in the ground-level monitoring data between 8:00 a.m. and 11:00 a.m. At night, ground-level monitors measure low ozone concentrations while monitors aloft measure much higher levels. At night, the elevated reservoir is separated from the surface by the nocturnal inversion. As the next day begins, temperatures increase, the inversion begins to collapse and the elevated ozone reservoir begins mixing down to the surface. In general, the ozone levels measured aloft at night mix down and create a regional transport contribution seen in ground-level monitors across the region. This “regional transport signal” can often approach or exceed 75 ppb. Local emissions begin to contribute to ozone production in the morning as well. Regional transport and local emissions combine to drive daily peak ozone levels in the late afternoon (see Figure 2).\textsuperscript{24-27}

A classic, real-world case study helps demonstrate how regional NO\textsubscript{x} reduction efforts can significantly lower ozone levels in the East. In 1997, 37 states and the District of Columbia participated in a collaborative effort, called the Ozone Transport Assessment Group (OTAG), to look at the transport of ozone in the East. Partially driven by that effort, in 1999 EPA adopted a federal program, called the NO\textsubscript{x} State Implementation Plan (SIP) Call, to address ozone transport and help states satisfy the “good neighbor” requirements of the U.S. Clean Air Act (CAA). The NO\textsubscript{x} SIP Call required a first round of meaningful NO\textsubscript{x} reductions from EGUs in the 2003 to 2004 time frame. Around the same time, the federal Tier II vehicle standards also began to add NO\textsubscript{x} reductions (volatile organic compounds [VOCs] were the focus of earlier federal standards).\textsuperscript{28}

As Figure 3 shows, controls were added, regional NO\textsubscript{x} emissions went down, ozone levels in the elevated reservoir were reduced, and ground-level ozone levels dropped dramatically.\textsuperscript{10,29,30}

Filling the Reservoir

Which states and sources contribute to filling the elevated reservoir? The answer is that it varies from day to day. There are, however, some general observations that appear to be supported by Maryland’s research and modeling.

Westerly transport is often a major factor when high pressure is located over the Southeast and the resulting aloft winds flow, clockwise, over the Ohio River Valley.\textsuperscript{31,32} This classic ozone weather pattern often carries transported ozone and ozone precursors from power plants into the Mid-Atlantic region. This scenario can cover multiple days.
Southerly transport at night also appears to be important. On most bad ozone days, wind profilers along the East Coast show nighttime aloft winds moving from the south to the north funneled by the Appalachian Mountains on the west and the Atlantic Ocean on the east.

This nocturnal low level jet, measured by wind profilers, can reach wind speeds as high as 35 mph. Nighttime ozonesonde launches show that ozone levels being carried by the nocturnal low level jet are routinely in the 50–70-ppb range and can get as high as 100 ppb. It appears that this type of transport can move ozone for several hundred miles over night and has a significant mobile source fingerprint. In addition, the effects of a bay-breeze are often observed at monitoring stations near Baltimore. During the bay-breeze, air masses with both local and imported ozone pass from the western shore to the Chesapeake. Over the bay, ozone continues to form, until the winds reverse and ozone-enriched air returns to shore. During a 30-day aircraft and ozonesonde measurement campaign in July 2011, one monitoring site recorded eight ozone violations for which the bay-breeze was a factor. The bottom line is that the contribution to the elevated ozone reservoir changes with weather. Westerly, southerly, sometimes northwesterly, and occasionally northeasterly flows are all important. EGUs, mobile sources, and other source sectors all appear to play a significant role in creating the elevated ozone reservoir.

The other type of important transport is city-to-city or short-range transport. For example, Baltimore’s plume floating at ground level into Philadelphia and Washington’s plume floating into Baltimore. This type of short-range transport is separate from the elevated ozone reservoir, but it is another significant way that emissions from close-by, upwind states contribute to downwind problem areas.

The Path Forward
In the East, the formula is simple: Cost-effective regional NOx control programs complimented by smart local efforts that target each area’s unique...
local contribution to the problem will continue to drive progress with ground-level ozone.

**Regional Transport**

As states move forward and begin to develop plans to continue making progress with ground-level ozone, a new level of partnership with EPA will be needed. The CAA is often recognized as a good example of cooperative federalism where state and local governments work with EPA in partnership to provide clean air in a way that fosters economic prosperity. This partnership is now more important than ever.

Between 2005 and 2010, EPA and the states worked together to identify priority source categories that would have the largest eastern and national emissions of NOx, sulfur dioxide (SO2), and mercury (Hg) remaining in 2020. This effort identified six source categories that represented 75% of the remaining NOx emissions that could be targeted for additional reductions. These categories included EGUs; on-road mobile sources; institutional, industrial, and commercial (ICI) boilers; cement kilns; marine engines; and locomotives. These six categories also represented 85% of the SO2, and 75% of the Hg emissions left to control in 2020.38-42 EPA has moved forward with initiatives to reduce national or regional NOx emissions from many of these priority source categories and much of the recent progress on ozone reduction is linked to these actions. Earlier actions on marine and locomotive engines, the Tier 2 Vehicle Standards, and the NOx SIP Call combined with more recent efforts like the Tier 3 Vehicle and Fuel Standards, the Mercury and Air Toxics Standard (MATS), Boiler MACT, and a series of mobile source actions on greenhouse gases that will provide ozone co-benefits have, and will continue to, help lower ozone levels.33 It’s clear that regional NOx reductions drive down ozone across the East. So how do we continue to do more of that?

The state/EPA partnership on prioritizing important sectors by potential future multipollutant reductions provides a model to identify the next set of national or super-regional reduction programs that may be needed. The effort should be designed to analyze strategies to find the “biggest bang for the buck” and to look at multipollutant benefits. In many cases, at the national or super-regional level, a small set of source categories dominate emission contributions for ozone, fine particulates, SO2, NO2, Hg, haze, and greenhouse gases.

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7. Maryland Department of Environment’s innovative measurements to investigate pollution transport into Maryland. See http://www.mde.state.md.us/programs/Air/AirQualityMonitoring/Pages/Network.aspx.
One of the issues that continues to be discussed over the new ozone standard is that many new areas, particularly less populated areas, will be forced to try and solve a problem that they simply cannot solve alone because local emissions are relatively small. The need for regional controls is important for historically difficult nonattainment areas like Baltimore and New York, but they are actually much more important to new areas that may be nonattainment for ozone in the future.

**Local Transport**
Addressing the local contribution to ozone is important, but if done alone, without addressing the regional contribution, will fail. It is critical for local strategies to be “smart”. What works in the Mid-Atlantic may not work in the South. As an example, Maryland and other Northeast states are working to drive down local mobile source emissions of NOx along the I-95 corridor. Emissions for major point sources are accurately monitored, but substantial uncertainties remain in emissions for mobile sources. Our research tells us that a focus on mobile sources is an important area to drive future progress.

Examples of the kind of local efforts being made in this area include the recent efforts by eight states on Zero Emission Vehicles (ZEVs), the OTC Aftermarket Catalyst model rule, and nontraditional initiatives to enhance SMARTWAYS efforts and to work with ports. The common thread in all of these is reducing NOx, but all of these efforts also have multipollutant benefits.

Maryland is also working with neighboring states to further reduce VOC emissions, which continue to be a meaningful contributor to ozone at our urban monitors. Recent efforts include updates to three model rules developed by the Ozone Transport Commission for consumer products, paints, and auto body shops. This is a good example of a strategy that would be smart for some areas, but less likely to be successful in other areas like the South where biogenic VOCs are dominant when compared to anthropogenic VOCs.

**Enhanced Collaboration**
Two more observations from the past 30 years: Legal challenges by the environmental community occasionally slow down environmental progress; and legal challenges by the private sector can lead to inefficient regulatory processes and a planning landscape for the business community that is impossible to navigate. Both hurt the nation’s economy. This seems like an area that needs to be addressed.

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explored and may be as important to future environmental and economic progress as the science giving us a clear technical path forward.

Having worked collaboratively with other government agencies, the environmental advocacy community and the private sector, we believe an enhanced effort to collaborate is critical and that such an effort could work. The CAA is a very powerful and functional legal framework to work from. Sometimes the solutions to the problems we struggle with lie within the gray areas of the law and require buy-in from multiple parties if they are to work. Clear environmental progress is essential. We cannot let perfection be the enemy of the very good.

Critical Emerging Ozone Research
One of the most policy-relevant, emerging research areas MDE is working on with the University of Maryland involves changes to the atmosphere over the past 15 years that may be affecting the chemistry of ozone production. These changes appear to support the hypothesis that we have reached a tipping point, where a ton of NOX reduction in the 2015–2025 time frame will generate meaningfully more ozone reduction than it did just 15 years ago. This is a critical issue as we move toward a new standard. Stay tuned.

Evolving Markets
When markets change, market-based programs sometimes need to be tweaked. Over the past few years, changes in the electricity markets have created a situation where installed EGU control equipment for ozone does not need to be used effectively during bad ozone periods because of the flexibilities built into the market-based regulatory system under which many of these sources operate. This issue is already being discussed and appears to be moving toward resolution. That said, investing in billions of dollars worth of ozone controls and then not using them when it matters, is an issue that must be fixed.

Conclusion
Maryland is thoroughly convinced that continued significant progress on reducing ground-level ozone is within our grasp. The science linked to what else we need to do is solid. Continued progress in the future will, however, take a new level of partnership involving states and local agencies, EPA, the private sector, and the environmental advocacy community.

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by Bryan Shaw, Sabine Lange, and Michael Honeycutt

Lowering the Ozone Standard Will Not Measurably Improve Public Health

The Texas Commission on Environmental Quality argues that the thoughtful integration of scientific data does not support the assumption that tightening the ozone standard will result in measurable health benefits.

The Texas Commission on Environmental Quality (TCEQ) strives to protect our state’s public health and natural resources consistent with sustainable economic development. In accordance with this mission, the State of Texas alone has spent >$1 billion since 2001 striving to achieve the 1997 0.08 parts per million (ppm) ozone standard. Most of Texas’ air quality areas recorded their lowest ozone values ever in 2014. The Houston and Dallas/Fort Worth areas, for example, have seen ozone levels reduced 29% and 21%, respectively, during the past 15 years, while the population has increased 34% and 29%, respectively. We will continue to expend resources to achieve the 2008 75 parts per billion (ppb) ozone standard, which has yet to be fully implemented by the U.S. Environmental Protection Agency (EPA). However, as the concentration of ambient ozone decreases, it becomes exponentially more difficult, and expensive, to attain further reductions. EPA is poised to lower the standard further. While cost cannot be considered in setting the standard, the high cost of further lowering the standard necessitates that this be a sound policy decision and will result in measurable health benefits.
EPA bases its proposal to lower the ozone standard on three key health-related endpoints: premature mortality, respiratory morbidity (i.e., asthma exacerbation, emergency department visits, and hospital admissions), and lung function (i.e., primarily FEV₁ [Forced Expiratory Volume in 1 second, a measure of lung function] decrements). We agree that respiratory effects can occur at the high ozone concentrations that were measured in the 1980s and 1990s. The pertinent question is whether lowering the ozone standard from 75 ppb to 70 or 65 ppb will result in a measurable reduction in these effects. In this short review, we consider some important concerns with EPA’s conclusions about the health effects of ambient ozone concentrations. We conclude that EPA has not demonstrated that public health will measurably improve by decreasing the level of the ozone standard.

Ecological Epidemiology Studies, Not Adequate for Setting Standard
EPA relies heavily on ecological epidemiology studies for its assessment of premature mortality and respiratory morbidity. These studies have been very inconsistent in their findings, and flaws, biases, and unusual characteristics of the data have made them difficult to interpret. One unusual and as-yet unexplained characteristic of the epidemiological associations between short-term ozone exposure and mortality is regional heterogeneity. This heterogeneity means that different cities have different associations between short-term exposure to ozone and mortality, and very few of those associations are positive.¹ ⁴

For example, Smith et al.¹ found that only 7 of the 98 cities investigated showed a statistically significant positive association between 8-hr ozone concentrations and mortality (this is very close to the 5% that would be expected purely by chance). Additionally, there was no association between the estimated effect of ozone on mortality for a city and the concentration of ozone in that city (see Figure 1 on page 28). EPA⁵ estimates short-term mortality impacts based on Zanobetti and Schwartz⁴ and the Smith et al. study.¹ However, the concentration response functions (CRFs) vary from negative to positive for the same city, depending on study selection, ozone averaging time, model specifications, and ozone season. In fact, most of these estimates are indistinguishable from zero. EPA uses a pooled nationwide estimate for their risk calculations, but the substantial heterogeneity between cities that ranges from positive to null or even negative (i.e., higher ozone concentrations correlated with reduced mortality) makes this nationwide estimate misleading and overestimates ozone risk.

The relationship between long-term ozone exposure and mortality has been investigated in at least 12 epidemiology studies.⁵ ¹⁷ When considering other potential causes of mortality, such as other air pollutants, only one of those studies¹⁵ showed a statistically significant (but very small) effect of ozone on respiratory mortality. Interestingly, the effect only occurred at temperatures above 82 °F. It is known that very warm or very cold temperatures are associated with increased mortality.¹⁸ Paradoxically, the increased mortality was not observed in U.S. regions with the highest ozone concentrations (e.g., Southern California) nor in areas with the highest number of respiratory deaths (e.g., the Northeast and industrial Midwest). Therefore, long-term mortality studies also demonstrate unexplained regional heterogeneity and mostly don’t show associations between ozone and long-term mortality.

Ozone ecological epidemiology studies suffer from severe exposure measurement error.
Evaluating the Nature of Ozone in the Context of Respiratory Health Outcomes

Altogether, this means that it is highly unlikely that the measured associations between ozone and respiratory mortality/morbidity are plausible, because the ozone exposures of the people in the population are so low. Were all of the hundreds of thousands of people in the epidemiology studies outside for 8 hours the day immediately before their deaths? In fact, this concern was raised by the Clean Air Scientific Advisory Committee (CASAC) ozone review panel, EPA’s scientific advisors, in a June 5, 2006 letter25 to EPA: “The Ozone Staff Paper should consider the problem of exposure measurement error in ozone mortality time-series studies. It is known that personal exposure to ozone is not reflected adequately, and sometimes not at all, by ozone concentrations measured at central monitoring sites...Therefore, it seems unlikely that the observed associations between short-term ozone concentrations and daily mortality are due solely to ozone itself.” This difference between ambient ozone concentrations and personal exposures is critical for interpreting both epidemiological studies as well as clinical exposure studies.

Lung Function Decrements Unlikely to Be Adverse Below Current Standard

The TCEQ agrees with EPA that the ozone clinical data are best for setting the ozone standard. The American Thoracic Society (ATS) defines adversity as a significant decrease in FEV₁ with a significant increase in symptoms.26 The ATS notes that FEV₁ decrements can vary by as much as 5% in healthy adults within a single day and by 15% or more from year to year. EPA defines a 10% FEV₁ decrement in a sensitive population as an appropriate adverse effect to protect against because it is mild and reversible. EPA asserts that two clinical studies, by Kim et al.27 and Schelegle et al.,28 justify lowering the current 75-ppb standard.

The Kim study reported statistically significant FEV₁ decrements (1.71%) in healthy young adults after 6.6 hours of 60-ppb ozone exposure while exercising heavily for 50 minutes out of every hour. However, these decrements are within normal variation and are not adverse by either the ATS criteria (i.e., because they were not statistically significant).

Studies20,21 that have investigated ozone personal exposure and compared it to ambient concentrations have found that personal exposure is much lower than ambient exposure (i.e., approximately 10% of the measured ambient level), and that there may not even be a correlation between personal and ambient concentrations.22,23 Even outdoor workers—whom EPA considers to be an at-risk population—experienced personal ozone concentrations that were only 60% of ambient concentrations.24 Because of this personal exposure issue, the use of ambient ozone concentrations as a proxy for ozone exposure concentrations grossly overestimates their exposure, and therefore risk. This is particularly true of the short-term mortality data, where the subjects of the study (who are mostly elderly) are within days of death when the ambient concentrations are measured, and so are even less likely to be outdoors.

Ecological epidemiology studies suffer from severe exposure measurement error; because they assume that people are continuously exposed (i.e., 24 hours a day, 7 days a week) to the pollutant concentrations measured at the ambient monitors. In the case of ozone, this error is even more egregious because of the nature of ozone as a pollutant. Ozone is primarily an outdoor pollutant, with ventilation and indoor structures scavenging it and removing it from indoor air. The average American adult, senior citizen, and child will spend only 5.3%, 5.8%, and 7.9% of their time outdoors, respectively,19 and so they will often not be exposed to ozone.

Studies that have investigated ozone personal exposure and compared it to ambient concentrations have found that personal exposure is much lower than ambient exposure (i.e., approximately 10% of the measured ambient level), and that there may not even be a correlation between personal and ambient concentrations.22,23 Even outdoor workers—whom EPA considers to be an at-risk population—experienced personal ozone concentrations that were only 60% of ambient concentrations.24 Because of this personal exposure issue, the use of ambient ozone concentrations as a proxy for ozone exposure concentrations grossly overestimates their exposure, and therefore risk. This is particularly true of the short-term mortality data, where the subjects of the study (who are mostly elderly) are within days of death when the ambient concentrations are measured, and so are even less likely to be outdoors.

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associated with symptoms), or by EPA’s criteria (i.e., because they were less than 10%).

The Schelegle study reported statistically significant FEV₁ decrements—5.34%, 7.23%, and 11.42%, respectively—associated with symptoms in healthy young adults after 6.6 hours exposure to 72-, 81-, and 88-ppb ozone, but not 63-ppb ozone, while exercising heavily for 50 minutes out of every hour. For 72-, 81-, and 88-ppb ozone, this exposure meets the ATS criteria for adversity, but at 72- and 81-ppb, it does not meet EPA’s criteria of adversity until 88-ppb, which is above the current standard.

To claim that the lung effects at 60- and 72-ppb from the Kim study and the Schelegle study are adverse, even though the group mean FEV₁ decrements were not adverse, EPA notes that at 60-ppb, 3 of 59 study subjects had FEV₁ decrements greater than 10%, and at 72-ppb 5 of 31 individual participants had FEV₁ decrements greater than 10%. EPA is essentially basing its assertion of adverse effects occurring at concentrations lower than the current standard on these eight individual measurements.

On the other hand, 5 of 31 individual participants had increases in FEV₁ after 72-ppb exposure. The remaining participants showed little, if any, change in FEV₁, altogether confirming the known large inter-individual variability in lung function responses. Lung function returned to baseline for all of the participants within 1–4 hours after cessation of exposure.28 As noted by Folinsbee et al.29 and McDonnell et al.,30 the exposure regimens used in the Kim and Schelegle studies simulate work performed during a day of heavy manual labor in outdoor workers. This is an unrealistic exposure scenario for sensitive subpopulations, such as asthmatic children and elderly chronic obstructive pulmonary disease patients. In addition, these lung function decrements would be transient, reversible, would not interfere with normal activity, and would not result in permanent injury or respiratory dysfunction.31

Further, EPA evaluated these effects based on exposure concentration, not dose (i.e., a function of exposure concentration, time, and ventilation rate). The healthy young study participants exercised vigorously for the majority of their 6.6 hour exposure, which in turn, would result in higher ventilation rates than EPA’s criteria (15 liters per minute).

EPA has not demonstrated that lowering the ozone standard from 75-ppb to 70–65-ppb will result in a decrease in adverse lung function effects in the population.
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exposure, dramatically increasing their dose, and therefore response, as compared to a resting or moderate exercise ventilation rate for the same exposure concentration. Given these facts, EPA has not demonstrated that lowering the ozone standard from 75 ppb to 70–65 ppb will result in a decrease in adverse lung function effects in the population.

Evidence for Ozone Exacerbation of Asthma Is Insufficient

EPA investigated the epidemiology studies that show effects of ambient ozone concentrations on asthma health outcomes. Keeping in mind that these studies suffer from the same exposure measurement errors as the mortality studies, EPA showed that 21 of the 33 reported associations between ozone and asthma symptoms were not statistically significant, and those that were significant were not consistent with one another. This result is quantified in the regulatory impact analysis, where EPA shows that there is no statistically significant decrease in asthma exacerbations with a decreasing level of the ozone standard. EPA also states that emergency department visits and hospital admissions are robust to co-pollutant confounders, but does not mention investigation of confounding by pollen, which is a known, strong inducer of asthma. Also, confounding by race, ethnicity, and household poverty are important considerations, as was shown in a recent study demonstrating that asthma incidence and morbidity is not more associated with urban (more polluted) areas, but rather with ethnicity and poverty. Therefore, EPA should not have drawn the conclusion that ozone enhances asthma morbidity at ambient concentrations based on these data.

In conclusion, the TCEQ thinks the thoughtful integration of the scientific data does not support the assumption that lowering the ozone standard from 75 ppb to 70–65 ppb will result in measurable health benefits. The ecological epidemiology studies are critically flawed due to severe exposure misclassification because personal exposure to ozone is approximately 10% of ambient levels, dramatically reducing the ozone dose people actually receive. The clinical studies do not indicate anything beyond mild, reversible effects below 75 ppb. It is biologically implausible that 8-hr ambient ozone concentrations below 75 ppb would cause mortality when they do not cause mild effects.
Do We Really Need to Tighten the Ozone Standards NOW?

75 ppb

65 ppb
The American Petroleum Institute is in support of retaining the current ozone standards, arguing that the proposed new standards may impose real costs on real people without commensurate benefit.

In 2007, Feldman and Langworthy\(^1\) presented arguments why tighter ozone National Ambient Air Quality Standards (NAAQS) were not requisite under the U.S. Clean Air Act (CAA). Nonetheless, on March 27, 2008, President Bush’s U.S. Environmental Protection Agency (EPA) Administrator Stephen Johnson promulgated the most stringent standards ever.\(^2\) Subsequently, President Obama’s EPA Administrator Lisa Jackson proposed further tightening the ozone NAAQS in 2010.\(^3\) EPA’s proposal would have made it one of the most expensive regulations ever issued, with an EPA estimated cost impact range of $19 billion to $90 billion and would have doubled the number of counties in violation.\(^4\) That effort to tighten the standards ended on September 2, 2011, when President Obama instructed EPA Administrator Jackson “…to withdraw the draft Ozone National Ambient Air Quality Standards at this time.”\(^5\) President Obama underscored the importance of reducing regulatory burdens and regulatory uncertainty.

EPA has nevertheless proposed again to adopt stringent NAAQS for ozone. As described below, there are four points supporting retention of the current standards: 1) industry is helping make the air cleaner today and in the future; 2) there is actually far more debate on the science underlying the ozone proposal than has been represented by EPA; 3) attaining tighter standards would be problematic; and 4) the proposed new standards may impose real costs on real people without commensurate benefit.

Industry Is Reducing Emissions
Since the federal CAA was adopted in 1970, EPA, states, and local communities have taken many steps to improve air quality. Industry, too, has contributed to this process. For example, refineries across the nation have implemented new processes designed to produce dramatically cleaner fuels. EPA lowered vehicle emissions standards and imposed additional fuel reformulation through its Tier 3 regulations on April 28, 2014.\(^6\) According to EPA, “…the non-methane organic gases (NMOG) and nitrogen oxides (NO\(_x\)) presented as NMOG+NO\(_x\) tailpipe standards for light-duty vehicles represent approximately an 80% reduction from today’s fleet average and a 70% reduction in per-vehicle particulate matter (PM) standards. The heavy-duty tailpipe standards represent about a 60% reduction in both fleet average NMOG+NO\(_x\) and per-vehicle PM standards.”\(^7\)

Other industries have also reduced their air emissions. As a result, as you can see from Figure 1, emissions of the six criteria air pollutants decreased 62% between 1980 and 2013,\(^8\) while the number of miles driven increased 95%. In additional to the mobile source emissions reductions that will continue, EPA is proposing other rules such as its suite of greenhouse gas regulations for power plants that will reduce ozone precursors in the future. Air quality will continue to improve without tightening the ozone standards.

Ozone Science Is Uncertain
As Feldman and Langworthy (2007) explained, EPA must set NAAQS at the level that is requisite—neither more nor less stringent than necessary—to protect the public health and welfare. In 2008, EPA established both primary (based on protection of public health) and secondary (based on protection of public welfare) NAAQS for ozone at an 8-hr average level of 0.075 parts per million (ppm). At that time, the EPA administrator determined that those standards were at the level requisite to protect health and welfare.\(^9\) Now, the administrator has proposed to tighten those standards.

As explained below, however, the current scientific evidence does not demonstrate that the present standards fail to protect the public health and welfare with an adequate margin of safety. As
Feldman and Langworthy explained, the current standards should be retained unless it is demonstrated that the new standards are requisite. Given the evidence described below, and many other uncertainties, changes in the standards are not requisite at this time.

According to Dr. Michael Honeycutt, Director of the Texas Commission of Environmental Quality Toxicology Division: “EPA’s proposed lower ozone standard derives much of its claimed benefits from associating ozone with worsening asthma. The problem with this association is that asthma diagnoses are increasing in the United States, yet nationwide, air quality is improving. If asthma were actually tied to ozone, you would expect to see the instances of asthma decreasing, not increasing. In fact, data from Texas hospitals show that asthma admissions are actually highest in the winter, when ozone levels are the lowest.”

Goodman, et al., concluded: “Overall, controlled human exposure studies do not demonstrate a causal association between ozone concentrations in the range of current NAAQS and adverse effects on lung function.”

In its proposal, EPA notes that: “With regard to lower exposure concentrations, the Administrator notes that the combination of statistically significant increases in respiratory symptoms and decrements in lung function has not been reported. More specifically, she notes that respiratory symptoms have been evaluated following 6.6-hour exposures to average ozone concentrations of 60 ppb (Adams, 2006; Kim et al., 2011) and 63 ppb (Schelegle et al., 2009) and that none of these studies reported a statistically significant increase in respiratory symptoms, compared to filtered air controls.”

Even EPA indicates that “[t]he Administrator has decreasing confidence that adverse effects will occur following exposures to O₃ concentrations below 72 ppb.”

Goodman, et al. evaluated studies of humans exposed to ozone under controlled conditions. Specifically, they evaluated the data from studies of controlled human exposures below 80 parts per billion (ppb) using the Adverse Effects/Causation Framework. They found: “…below 72 ppb, lung function effects are primary effects, but are isolated, independent and not statistically different in subjects exposed to ozone compared to those exposed to fresh air; indicating a lack of causation. Up to about 72 ppb, lung function effects are not adverse because they are transient, reversible and of low severity, as they do not interfere with normal activity and do not result in permanent respiratory injury or progressive respiratory dysfunction.”

Goodman, et al., concluded: “Overall, controlled human exposure studies do not demonstrate a causal association between ozone concentrations in the range of current NAAQS and adverse effects on lung function.”

EPA and the states can best contribute to better air by helping communities attain the existing standards.
Unfortunately, tightening of the standards may cause adverse health consequences, which are often ignored. As described by Amy Gutman in the Harvard Public Health magazine, there is substantial evidence linking job losses to shorter lives and more health-related problems. Gutman cites Sullivan and von Wachter as having found that in the year after men lost their jobs in mass layoffs, their chances of dying doubled. And though the heightened risk tapered off over the years, it was still significantly higher 20 years later. In testimony, von Wachter indicated that job loss is also typically followed by an extended period of instability of employment and earnings and that during this period, job losers can also experience declines in health. Furthermore, von Wachter indicates that the consequences of job loss are also felt by workers’ children, who can suffer from the consequences even as adults, and by their families. As described below, there may be significant job impacts from tightened standards.

Attaining Tighter Standards Will Be Problematic

Unfortunately, tighter standards will be difficult or impossible to attain. The frequency of ozone exceedances would increase dramatically at standards below 0.075 ppm. Rather than an ozone exceedance being a relatively rare event, ozone exceedances will become common in both urban and rural areas. EPA’s Clean Air Status and Trends Network (CASTNET) is a national air quality monitoring network that operates more than 85 regional sites throughout the United States. According to EPA, sites are located in areas where urban influences are minimal. As indicated by EPA’s CASTNet data, pristine areas such as national parks, which have minimal local emissions, routinely exceed standards below 0.075 ppm, and would have design values of more than 0.065 ppm. By some estimates, 45 of the lower 48 states would have areas that exceed a 0.065-ppm ozone standard based on recent measurements and extrapolations.
Costs Will Be Real
A more stringent ozone standard will burden the states with a new and more difficult target before they complete work and implement attainment plans for the current standard. Previously, EPA estimated the cost of meeting 0.060–0.070-ppm standards to be $19 billion to $90 billion per year in 2020.17 According to a study done by NERA Economic Consulting using its integrated energy-economic model (NewERA), if EPA were to set an ozone standard of 0.060 ppm, the estimated potential emissions control costs would reduce U.S. Gross Domestic Product (GDP) by $270 billion per year on average from 2017 to 2040 and by more than $3 trillion in present value terms. The potential labor market impacts represent an average annual loss of 2.9 million job-equivalents. As described above, these impacts could have significant impacts on public health.18

One way EPA is now showing lower costs to attain the standards is that the agency has lowered its cost impact estimate of tightening the standards by significantly reducing the cost of “unknown” emissions controls. As noted by EPA, “[t]he form, locations, and timing of emissions reductions that would be undertaken to meet various levels of the ozone standard are unknown.”19 Nonetheless, to estimate cost impacts, EPA applies known controls and other unknown controls. Unknown controls are the controls determined to be necessary to reach the standards, after all known controls are applied. For some locations and potential standards, these unknown controls comprise as much as half or more of the necessary controls. So the cost of these controls is critical. For example, two-thirds of the tons to achieve 0.060 ppm are “unknown.” To estimate their cost/ton NERA identified the likely types of control measures that would have to be applied for these “unknown” controls. The result based on NERA’s evidence-based method is that unknown reductions would cost an average of $135,000/ton. This is contrasted with EPA’s 2010 assumption average of $32,000/ton. Now, without justification, EPA has halved its dollar-per-ton assumption for “unknown” actions to $15,000/ton,
even though its average dollar-per-ton cost for the “known” controls has tripled.

Many local communities will be saddled with new costs that will hurt both large and small businesses and prevent expansion and growth in many areas. Hurting local economies and citizens without a clear scientific basis for selecting a different numeric standard is not a prudent use of resources. EPA’s proposed revisions could perturb ongoing and planned implementation processes just now being put into place to meet the most recent changes in the current standard. In fact, on February 13, 2015, EPA finally released its guidance to states as to how to comply with the 2008 ozone standards. According to EPA, that guidance:

• Establishes due dates for air agencies to submit State Implementation Plans (SIPs) demonstrating how areas designated as nonattainment for the 2008 ozone NAAQS will meet the standards by the appropriate attainment date;
• Clarifies attainment dates for each nonattainment area according to its classification (established based on air quality thresholds); and
• Provides guidance on nearly all aspects of the attainment planning requirements for designated nonattainment areas.20

Conclusion
Of course, the CAA mandates that the ozone NAAQS be established based solely on science. Ten scientists knowledgeable about the science and policy issues underlying the setting of the NAAQS for ozone reviewed the available scientific information on ambient ozone and its health effects. They concluded that no scientific methodology can define the precise numerical level, related averaging time, and statistical form of the ozone standard and that these are policy judgments.21

Given the uncertainties in the health data and the significant impact that tightening the standards may have, EPA and the states can best contribute to better air by helping communities attain the existing standards. Chilling local economies before attaining the current standards and without compelling changes in the science makes no sense.

References
Before the Dust Can Settle,

NEW Ozone Standards

by Lucinda Minton Langworthy and Aaron M. Flynn

Lucinda Minton Langworthy is counsel and Aaron M. Flynn is partner, both with Hunton & Williams LLP, Washington, DC. E-mail: clangworthy@hunton.com.

The proposed revisions to the ozone standards, if they are adopted as proposed, may present new grounds for a judicial challenge.

The U.S. Environmental Protection Agency (EPA) recently proposed to revise the primary and secondary National Ambient Air Quality Standards (NAAQS) for ozone. This proposed rule would revise the existing 8-hr 75 parts per billion (ppb) primary NAAQS to a level within the range of 65–70 ppb. It would revise the secondary standard to match the revised primary NAAQS. Absent a significant reversal, the agency’s proposed action will require yet another round of dramatic emission reductions at a time when industry is struggling to comply with the agency’s growing regulatory demands.
This proposal comes just as implementation of the present ozone NAAQS, which were promulgated in 2008, gets underway in earnest. In 2012, EPA designated all parts of the country as either non-attainment, unclassifiable, or unclassifiable/attainment for the 2008 NAAQS.\(^{2,3}\) The nonattainment areas were classified as marginal, moderate, serious, severe, serious, or extreme and were given attainment deadlines that ranged from 2015 to as late as 2032, depending on their classification.\(^4\) At that time, EPA indicated that it planned to issue a rule instructing states on requirements for the plans they are charged with developing to bring the nonattainment areas into compliance by the relevant deadlines. EPA proposed such an implementation rule approximately one year later.\(^5\) The final version of this rule, however, was not signed until February 13, 2015, almost two months after EPA proposed revisions to the standards that the rule is intended to implement.\(^6\)

**Proposed Rule Means More Work for States, Industry**

Developing plans in accordance with the new implementation rule will involve an enormous amount of work by states and substantial commitments of state resources. At the same time that EPA’s new implementation rule is placing these burdens on the states, the proposed rule will potentially disrupt state planning activities by requiring states to redirect their efforts. EPA is causing this disruption without offering reasonable examples of strategies that all states could use to meet the current—let alone the newly proposed—ozone NAAQS, leaving the roadmap for compliance particularly uncertain. Indeed, in projecting in its Regulatory Impact Analysis (RIA) what would be required to attain a revised standard nationwide, EPA relies substantially on emission reductions from “unknown controls.”\(^7\) Which industries such unknown controls might apply to and whether those controls are cost-effective, or even technologically available, is unexplored territory.

That EPA’s proposed rule, if finalized, would be costly and burdensome to industries and their customers is beyond dispute. EPA’s RIA estimates the cost of attaining a revised NAAQS throughout the United States (excluding California) at $3.9 billion to $15 billion in 2025 alone.\(^8\) For California, EPA estimates costs only post-2025 because the agency does not believe that the state will attain by that date. The estimated cost to California industries and consumers of a revised NAAQS in the proposed range may be as much a $1.6 billion.\(^9\)

The proposed rule would disrupt the existing process to implement the 2008 NAAQS and impose these substantial additional costs even though the science on ozone health effects has not advanced in any appreciable way since the termination of reconsideration proceedings in 2011 or the prior NAAQS review. The human clinical studies identified in this review merely confirm the results of studies that were available as far back as 2002. Similarly, the epidemiological studies EPA has identified are subject to the same uncertainties as the studies relied on previously. Ultimately, none of the new research supports a finding of adverse human health outcomes at ozone concentrations lower than the level of the current primary standard.

Even if the evidence were interpreted as showing greater health risk from ozone than when EPA set the 2008 NAAQS, a revised NAAQS would likely do little to alleviate that risk. Much of the calculated health risk from ozone is attributable to ozone that simply cannot be reduced through the NAAQS program. This is the case for risk associated with background ozone (i.e., ozone that results from natural sources like lightning and vegetative emissions and from emissions from other countries). The U.S. Clean Air Act (CAA) provides no mechanism for reducing ozone from natural sources. Nor do the statutory requirements and schedules for states’ plans to attain an ozone NAAQS provide a mechanism for states to reduce ozone that originates abroad.

**Close to Background Ozone Levels**

As the ozone NAAQS are set closer to—or even at—background levels, however, states will face ever-increasing challenges with regard to fulfilling their obligation to provide for attainment of those NAAQS. Even the 2008 NAAQS is quite near background ozone levels. The proposed rule recognizes that ozone concentrations exceeding the...
current NAAQS can be “substantially influenced” by background.\textsuperscript{10} Significant background contributions to NAAQS exceedances would occur even more often with a more stringent NAAQS in the range that EPA has proposed. Moreover, background ozone in the United States is likely to increase as ozone-forming emissions in Asia rise.

The proximity of background ozone concentrations to the levels that EPA has proposed for revised ozone NAAQS means that the relationship between background concentrations and NAAQS is an issue that must be addressed during the present NAAQS review. It weighs against a further tightening of the ozone NAAQS. Both EPA and the U.S. Court of Appeals for the District of Columbia Circuit (D.C. Circuit), where all challenges to a revised NAAQS are heard, have recognized that NAAQS need not be set at zero-risk or background concentration levels.\textsuperscript{11} Furthermore, the D.C. Circuit upheld a prior EPA decision to set the ozone standard at 0.08 parts per million (ppm; essentially 84 ppb) instead of at 0.07 ppm (roughly 74 ppb), in part, because such a more stringent standard would have been closer to background ozone levels.\textsuperscript{12}

Despite past EPA precedent, approved by the D.C. Circuit, in this rulemaking EPA has so far insisted that it must set the level of the primary ozone standard “without regard to the source of the pollutant.”\textsuperscript{13} EPA has suggested that it may seek to reform its so-far-ineffectual “exceptional events” rule to better address background air quality. But with no current indication as to what those reforms might be and whether they would be effective and practical to implement, states and regulated sources have no assurance that they will be helpful in planning measures to attain a revised NAAQS. Similarly, although EPA points to CAA programs aimed at providing relief to rural and international border areas as options for addressing NAAQS exceedances attributable to background ozone concentrations, those programs have been of little assistance to states in the past and are of limited promise for the future. More fundamentally, however, because the proposed rule assumes that EPA should regulate ozone from whatever source, even background, the proposed NAAQS revision is based on a misinterpretation of the governing law and the scope of EPA’s discretion under the CAA. For that reason alone, the proposed revision of the primary ozone standard is not appropriate.

Problems with Secondary Standard

Much of the discussion above applies with equal force to the proposed revision of the secondary ozone standard. By proposing a secondary NAAQS set at the same level primary standard, the proposed rule implicates concerns over background ozone concentrations as to the public welfare-based NAAQS, as well as the health-based standard. And, as with the primary standard, the welfare effects science EPA cites in the proposed rule provides no reasonable basis for a standard set at such a low level.

The tone of the proposed rule’s discussion of the welfare effects science suggests that EPA recognizes the significant limitations in the record.
The proposal acknowledges that of the three key effects the EPA administrator has chosen to focus on—relative biomass loss in trees, crop yield loss, and visible foliar injury—only relative biomass loss provides a basis for setting a secondary standard, questioning whether adverse impacts can be discerned in the remaining effects categories. Even with relative biomass loss, the administrator recognizes that the 2% benchmark that EPA has relied on throughout the ozone NAAQS review as a measure of adversity for that welfare effect, in fact, lacks any rational basis. Given these, and many other scientific limitations, it is difficult to understand how EPA has decided a revision to secondary standard is appropriate.

One area in which the agency has provided a well-reasoned and reasonable proposal is in its decision to retain the current form of the secondary standard. Throughout this review, EPA has been considering abandoning the current standard’s form (i.e., the annual 4th highest daily maximum 8-hr ozone concentration) in exchange for a cumulative, seasonal standard, like the “W126” sigmoidally weighted index that has often been the focus of EPA’s analysis of the secondary NAAQS. Adopting a standard with a W126 form would bring new complexity and unknown variables to the NAAQS program, such as how existing monitors would perform in ensuring compliance with such a standard.

Wisely, EPA’s proposed rule is supported by a straightforward assessment comparing the level of protection under a W126 form standard with the level of protection that would be afforded by a standard in the traditional form, and that assessment shows that the two approaches offer equivalent protection. EPA’s approach to making this demonstration is, moreover, fully consistent with the D.C. Circuit’s decision in *Mississippi vs. EPA.*

In that case, the D.C. Circuit remanded EPA’s 2008 ozone standard to the agency because EPA set the secondary NAAQS equal to its revised primary standard without first identifying the level of protection that was “requisite to protect the public welfare.” Here, EPA has proposed to do precisely what the court required: it has identified a range of protection that it believes satisfies the CAA’s “requisite to protect” standard. It has, moreover, set that range, 17 ppm-hours to 13 ppm-hours, using the W126 metric, consistent with the recommendation of the Clean Air Science Advisory Committee. Accordingly, in this respect, the proposed rule is sound.

**Conclusion**

The bulk of EPA’s proposal, however, raises alarms. The agency is straining to find a scientific basis for revision of both the primary and secondary NAAQS when there have been no real scientific advancements to justify revision and the already-stringent current standards have not yet been fully implemented. The revised standards that EPA has proposed are so low as to test whether compliance will be possible in the face of current background concentration levels. EPA is proposing these extraordinary measures even though the D.C. Circuit has clearly ruled that EPA need not take such extreme action. Over the past few years, EPA has more often than not successfully defended its NAAQS in court. The proposed revisions to the ozone standards, if they are adopted as proposed, may, however, present new grounds for a judicial challenge.

**References**

2. 77 Fed. Regist. 34,221 (June 11, 2012).
5. 78 Fed. Regist. 34,178 (June 6, 2013).
8. RIA at ES-14, Table ES-6.
9. RIA at ES-17, Table ES-11.
10. 79 Fed. Regist. at 75242.
11. See Lead Indus. Ass’n vs. EPA, 647 F.2d at 1156 n.41.
13. 79 Fed. Regist. at 75242.
15. See Mississippi vs. EPA at 424-25 (quotations omitted).

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**NEW FOR 2015!**

**SUNDAY, JUNE 21**

**AIR–295: Air Quality Engineering**  
**INSTRUCTOR:** Mark Rood, Ph.D., BCEEM, Ivan Racheff Professor of Environmental Engineering, University of Illinois, Urbana–Champaign  

Participants will study air quality engineering fundamentals pertaining to the outdoor ambient environment, including background information that describes air pollutants, application of the ideal gas law, impacts of air pollutants, and air quality regulations for sources and the ambient environment. Overall methods to reduce the generation of emissions will be described and methods commonly used to selectively remove particulate matter and gases from gas streams will be discussed. Additionally, meteorology and dispersion of air pollutants emitted from point, line, and puff sources are described to predict concentrations of outdoor air pollutants at downwind receptors. There are no prerequisites for this course; however, having a scientific or engineering background would be beneficial.

**AIR–299: AERMOD Air Dispersion Modeling**  
**INSTRUCTORS:** Jesse Thé, Ph.D., P. Eng, Shawn Dolan, president, and Steve Rasmussen, president, both with Virtual Technology & Green Wire Technical Solutions, will be offering the course: CTAIR–145: EPA Alternative Method 082 Certification and Training

Dolan has more than 30 years of experience in information technology and information management. His air quality knowledge combined with his technology experience led to the creation of the Digital Opacity Compliance System Second Generation, which, in turn, championed the ASTM D7520, and its partner EPA Alternative Method 082.

Rasmussen previously served with the U.S. Air Force and managed the Air Quality Program at Hill Air Force Base in Utah for over 20 years. Additionally, he was responsible for the development of EPA Alternative Method 082. The first approved alternate test method to EPA Method 9 in 30 years.

**Christelle Escoffier, Ph.D., independent air quality specialist; and Irene Lee, senior scientist, Exponent Inc., will be offering the course:**  
**AIR–173: CALPUFF Introductory Course**

Dr. Escoffier has over 15 years of experience in the fields of meteorological and air quality studies using atmospheric dispersion models such as CALPUFF. She has conducted long-range air quality impact studies for BART assessments and PSD compliance and has also conducted near-field applications in simple and complex meteorological situations to assess compliance with air quality standards worldwide for aluminum smelters, power plants, and oil and gas facilities.

Lee has over 10 years of experience in meteorological and air quality modeling. She has performed numerous air quality impact studies worldwide using atmospheric dispersion models such as CALPUFF. Lee is also a primary contributor to the CALPUFF modeling system having developed numerous software packages, including the new CALApps graphical user interface (GUI) and Fortran processors.

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EMGM–285: Environmental Health Risks and Hazard Risk Calculations
INSTRUCTORS: Ryan Dupont, Ph.D., professor, civil and environmental engineering, Utah State University; and Lou Theodore, Eng.Sci.D., professor, chemical engineering, Manhattan College
▶ All types of environmental-related issues fall under the environmental risk umbrella. This course will provide attendees with an understanding of the principles of environmental risk and associated risk assessment calculations. Following a discussion of regulations, emergency planning and response, and applicable principles, the presentations will key on risk assessment calculations associated with health risk, hazard risk, and combined health/hazard risk scenarios. Topic discussions will be complimented with numerous illustrative examples and real-world case studies that include domestic, industrial, utility, and natural disaster-related situations. An undergraduate science or engineering degree is required.

EMGM–345: ISO 14001: 2015: Meeting the Requirements of the New Standard
INSTRUCTOR: Yogendra Chaudhry, Ph.D., EP, CRSP, director, Centre for Sustainable Development, Ketek Group Inc.
▶ The ISO 14000 series of standards address various aspects of environmental management. These standards provide practical tools for organizations looking to identify and control their environmental impact and continually improve their environmental performance. ISO 14001 sets out the criteria for an environmental management system and provides a framework that an organization can follow to set up an effective environmental management system. The standard is currently under review and it is expected that the new version of the standard will be released in 2015. This course will discuss the proposed changes and strategies to be prepared to meet the requirement of new versions of the standard and how to implement these changes in your existing environmental management system.

WASTE–245: Innovative Strategies and Technologies for Contaminated Site Remediation
INSTRUCTOR: Kevin Finneman, Ph.D., associate professor, environmental engineering, Clemson University
▶ This course will provide an introduction to site remediation strategies and technologies that will be applicable to a number of different contaminants, including chlorinated solvents, petroleum hydrocarbons, metals and metalloids, radionuclides, pesticides, and explosives/energetics. It is appropriate for both new learners and those with experience in site remediation. The course will focus on innovative and emerging tools for site characterization and remediation, while comparing and contrasting these “cutting-edge” practices with classical remediation techniques. The course will discuss how to design laboratory experiments in support of field remediation efforts, and to analyze and interpret molecular biology data, which are commonplace in today’s environmental remediation efforts. A take-home course workbook will be provided to all participants that will summarize the course sections, with practice questions and case studies, when applicable.

MONDAY, JUNE 22

AIR–173: CALPUFF Introductory Course
INSTRUCTORS: Christelle Escoffier, Ph.D., independent air quality specialist; and Irene Lee, senior scientist, Exponent Inc.
▶ This course will provide an introduction to the CALPUFF atmospheric dispersion modeling system, an advanced non-steady-state meteorological and air quality modeling system. It is an open source code recommended by the U.S. Environmental Protection Agency for assessing long-range transport of pollutants and their impacts on Federal Class I areas and on a case-by-case basis for near-field applications involving complex meteorological conditions. The course will focus on theoretical components of meteorological and dispersion modeling, new advancements and new features in the modeling system, and a new graphical user interface (CALApp).

AIR–240: Achieving Compliance for Combustion Processes via Air Pollution Control
INSTRUCTOR: Tom McGowan, president and founder, TMTS Associates Inc.
▶ The course will focus on the theory and operation of thermal systems and air pollution control. The interactions between the two are covered in detail. Attendees must know and understand both the “front end” combustion system and “back end” air pollution control systems to comply with myriad regulations and promote safe and economical operation. Part of the value of this course is the practical experience of the presenter and his knowledge of what works and what does not. Case studies will be used for illustration purposes.

CTAIR–145: EPA Alternative Method 082 Certification and Training
INSTRUCTORS: Shawn Dolan, president, and Steve Rasmussen, president, both with Virtual Technology & Green Wire Technical Solutions
▶ Become a certified U.S. Environmental Protection Agency (EPA) ALT 082 Visible Emission Operator, and get six months of DOCS II Software as a Service (SaaS) free with registration. Students will learn how to observe and make visible emissions using digital cameras and common mobile technology devices. Bring your smart phone/tablet/laptop and leave certified and ready to preform EPA ALT 082 Visible Emission Observations. The course will cover the basics of visible emission observation; how to properly frame and position digital cameras to record visible emissions; the required data for defendable opacity determinations; how to identify stationary and fugitive dust sources; imagery requirements; health concerns from visible emissions; and the most up to date legal interpollation and decisions.

INSTRUCTOR: David Elam, Jr., CIH, CMQ/OE, PMP, consultant, TRC Environmental Corp.
▶ Projects are how environmental service work gets done. While an educational background may prepare the environmental professional for the technical aspects of the work, one is typically expected to learn project management skills “on the job,” a situation that can end in disappointment for both the environmental professional and the project sponsor. Fortunately, project management skills can be learned, creating successful environmental project managers and sponsoring organizations. This course will help environmental professionals better serve their organizations and advance their careers through the development and improvement of project management skills. The course format will consist of presentations and exercises. Each participant will receive a course notebook containing a copy of presentation materials; no prerequisites are required.
▶ Visit the conference Web site at ace2015.awma.org for more updates.
The U.S. Environmental Protection Agency (EPA) refined its interpretation of a problematic amendment added to the U.S. Clean Air Act in 1990 as it prepared to defend the proposed Clean Power Plan from a coal company lawsuit seeking to block the rule before it is finalized.

In advance of oral arguments that were scheduled for April 16, EPA expanded and revised its interpretation of its authority to regulate carbon dioxide emissions from power plants under Section 111(d) of the Clean Air Act since it first proposed the Clean Power Plan in 2014.

EPA in a recent court brief to the U.S. Court of Appeals for the District of Columbia Circuit argued a House amendment to the Clean Air Act that critics say bars the agency from proposing its Clean Power Plan from a coal company lawsuit seeking to block the rule before it is finalized presents the agency with a unique opportunity to gauge the court’s response to how it interprets its authority, observers told Bloomberg BNA (In re Murray Energy Corp., No. 14-1112, D.C. Cir., merits panel assigned 3/18/15).

“"There are many, many ways to interpret a statute. At the end of the day, what’s going to really ultimately matter is whether a court is going to take an all-things-considered view of what the agency has done here," Michael Livermore, an associate law professor at the University of Virginia School of Law, told Bloomberg BNA.

At argument, EPA will face three Republican-appointed judges who may be inclined to limit the agency’s authority to regulate carbon dioxide emissions from the power sector, provided jurisdictional issues with the case can be resolved, lawyers said.

Argument Could Inform Final Rule
The D.C. Circuit has taken the unusual step of allowing Murray Energy’s lawsuit challenging EPA’s authority to issue the Clean Power Plan to proceed before the rule is finalized. The coal company is asking the court to use its authority under the All Writs Act to declare EPA lacks the legal authority to require the carbon dioxide reductions. Lawyers said the judges’ questions at argument could guide how EPA justifies its legal authority to issue the Clean Power Plan when the rule is finalized this summer.

“I think you’re going to see EPA attempt to adopt that kind of reasoning in the final rule,” Jacob Hollinger, a partner at McDermott Will & Emery LLP, told Bloomberg BNA.

EPA’s proposed Clean Power Plan (RIN 2060-AR33) would establish unique carbon dioxide emissions rates for the power sector in each state. Those standards would be implemented by the states, which would choose for themselves the best options for compliance. The Clean Power
Plan is the EPA’s most expansive reading of its authority under the rarely used Section 111(d) of the Clean Air Act, which has never been interpreted by the courts.

**Legal Authority Must Be Defended**

Before EPA can finalize the rule, it must defend its legal ability to propose the carbon dioxide standard.

In its lawsuit, Murray Energy is challenging the EPA’s Clean Air Act authority to issue the Clean Power Plan, arguing the rule is barred by the plain meaning of Section 111(d) of the act. The company argues the law bars EPA from regulating under Section 111(d) sources that already have been regulated under Section 112, such as power plants.

When the Clean Air Act was amended in 1990, the House and Senate approved conflicting amendments to Section 111(d). The Senate amendment would prevent EPA from regulating pollutants under Section 111(d) if they already are subject to hazardous air pollutant standards under Section 112. The House amendment can be read as barring the agency from regulating industrial sources, including power plants, under Section 111(d) if they are subject to standards under Section 112. Both provisions were included in the final bill.

Interpreting that language presents the largest legal impediment to EPA’s power plant proposal, attorneys said.

“There is almost nothing EPA can do about that other than argue what it has,” Thomas Lorenzen, a partner at Dorsey & Whitney LLP, told Bloomberg BNA.

Lorenzen, Livermore, and Hollinger are not involved in the Murray Energy litigation.

**Legal Interpretation Changing**

In a legal memorandum issued with the proposed Clean Power Plan in 2014, EPA argued the conflicting amendments created a statutory ambiguity to be interpreted by the agency.

In 2005, when EPA issued the Clean Air Mercury Rule, the agency offered an interpretation of those two amendments that only barred the agency from regulating under Section 111(d) those pollutants regulated under Section 112. “The EPA explained that this approach reasonably interprets the Section 112 exclusion to give some effect to both amendments,” the agency said in the 2014 legal memorandum.

The Clean Air Mercury Rule eventually was overturned by the D.C. Circuit, but the court never reached the agency’s interpretation of Section 111(d) in that case.

Since Murray Energy has challenged EPA’s authority to propose the rule under Section 111(d), EPA has refined its defense, arguing that not only do the conflicting amendments create statutory ambiguity, but that the House amendment alone is open to various interpretations and therefore ambiguous.

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**Member in the News**

A&WMA President Dallas Baker has been appointed Air Director and Chief of the Mississippi Department of Environmental Quality’s (MDEQ) Air Division. Baker has more than 21 years of experience as an environmental engineer with MDEQ and most recently served as Chief of the Management Support Branch in the Environmental Permits Division.

“I began my employment at MDEQ with seven years in the Air Division, and it’s an honor to return in this new capacity. Much of the environmental public policy discussions at the national and local levels deal with air issues, and I am excited to be a part of that,” said Baker. Baker has conducted PSD/NSR reviews for a number of projects, and has written Title V operating permits for energy, chemical, manufacturing, and other air pollutant emitting industries.

Baker graduated from the University of Mississippi with a bachelor’s degree in mechanical engineering and a master’s degree in environmental engineering. Additionally, he earned an MBA from Mississippi College. He is a licensed Professional Engineer and is board certified by the American Academy of Environmental Engineers and Scientists. He also serves on the Ole Miss School of Engineering Advisory Board as Chair of the Geological Engineering Committee.
EPA in a brief argues the House language prevents EPA from using Section 111(d) to regulate pollutants that are listed as criteria pollutants or hazardous air pollutants or using that section to regulate sources that are regulated under Section 112.

Section 111(d), as amended by the House, says EPA can issue emissions guidelines for “any air pollutant for which air quality criteria have not been issued or which is not included on a list published under section 7408 [addressing criteria pollutants] of this title or emitted from a source category which is regulated under [Section 112] of this title.”

EPA argues the “or” in that section is significant because it means carbon dioxide must meet only one of the three criteria to be subject to standards under Section 111(d). While power plants as a source category already are subject to the mercury and air toxics standards issued under Section 112, carbon dioxide is neither a criteria pollutant nor a hazardous air pollutant.

“In other words, the literal language of [Section 111(d)] provides that the administrator may require states to establish standards for an air pollutant, so long as either air quality criteria have not been established for that pollutant, or one of the remaining criteria is met. Air quality criteria have not been issued for [carbon dioxide]; thus, whether power plants have been regulated under [Section 112] is arguably irrelevant,” EPA said in its brief.

**Previous Challenge Dismissed**

While EPA may have refined its interpretation of its authority, David Doniger, director of the Natural Resources Defense Council’s climate and clean air program, told Bloomberg BNA that Murray Energy still faces significant procedural and jurisdictional hurdles before the D.C. Circuit can reach the merits of the coal company’s interpretation of Section 111(d). The Natural Resources Defense Council has intervened in the lawsuit on behalf of EPA and wrote a plan for regulating the power sector that influenced the agency’s Clean Power Plan.

The D.C. Circuit has been skeptical of past attempts to challenge EPA rules before they are finalized. In 2012, the court quickly dismissed a lawsuit brought by power companies that sought to block proposed carbon dioxide performance standards for new power plants issued under Section 111(b) on the grounds that a proposed rule is not final agency action and therefore not subject to judicial review (Las Brisas Energy Center LLC vs. EPA, D.C. Cir., No. 12-1248, 12/13/12).

Although the D.C. Circuit will hear arguments in Murray Energy’s lawsuit, Doniger predicted the same “two sentence dismissal.”

“I’m really, really hard pressed to see how that doesn’t happen again,” he said.

EPA certainly would have restated and refined its interpretation of its legal authority to issue the Clean Power Plan in the final rule, but Murray Energy’s lawsuit forced the agency to take a fresh look at its authority, providing a new opportunity to frame its legal arguments, attorneys said.

“Certainly the fact that Murray has pressed the issue has forced the agency to think very carefully about the bases for its interpretation of the statute,” Lorenzen said. “They likely would have done that anyway.”—By Andrew Childers, Bloomberg BNA
Report Suggests Trading Approach for States Awarding Emissions Rate Credits

States could be encouraged to enter into cap-and-trade agreements to meet U.S. Environmental Protection Agency (EPA) power plant carbon pollution limits—arrangements that would award states tradable credits for cutting their emissions rates below what EPA requires, Resources for the Future (RFF) said in a report.

RFF’s report, “A Proximate Mirror: Greenhouse Gas Rules and Strategic Behavior under the U.S. Clean Air Act,” seeks to address a key complication of the proposed EPA carbon dioxide limits, which would assign emissions rates standards that vary from state to state. Because electricity is delivered across multiple states by utilities, the EPA rule could create unintended incentives “to shift generation and investment to the jurisdiction with a less stringent standard,” according to the report. That shift, in turn, “may lead to the utilization of different fuels and technologies, ultimately increasing emissions of carbon dioxide, as well as changing the location and magnitude of other pollutants, including sulfur dioxide and nitrogen oxides.” The report suggested power generators be awarded credits, which could be traded in the multi-state emissions trading system, for reducing emissions below an emissions rate standard.

Proposed in June 2014, EPA’s Clean Power Plan is the pivotal policy initiative of President Barack Obama’s Climate Action Plan, announced in 2013. It calls for cutting carbon dioxide emissions from existing power plants by 30% by 2030, compared to 2005 levels, and is to be finalized this summer. EPA Administrator Gina McCarthy has suggested cap-and-trade agreements between neighboring states are likely to provide the most cost-effective way for states to meet their reductions.

Kerry Urges States, Cities to Offer Pledges in Run-Up to Climate Talks

Secretary of State John Kerry urged U.S. states, as well as private industry and local governments around the world, to offer their own pledges to cut greenhouse gas emissions ahead of the December talks in Paris that are expected to conclude with a global climate accord. Kerry said he is optimistic the accord, which is to be the first to include actions from developed and developing nations alike, would be an “absolutely vital first step” toward a global low-carbon energy path.

A deal concluded between more than 190 nations, which is to enter into force in 2020, would send a signal “that countries everywhere are moving in this direction” toward low-carbon energy sources, Kerry said. The secretary said the Paris accord “has to be a truly all-hands-on-deck effort” and urged “all of our partners—business and industry groups, mayors, and governors, throughout the country and around the world—to announce their own targets, their commitments” in the months ahead. That bottom-up effort “can set an example and create a grassroots movement towards success” in Paris, Kerry said.

Investors Show Interest in Companies’ Response to Climate Change

Investors continue to show an interest during the 2015 proxy season in how companies are responding to climate change, with a stronger emphasis on potential business risks it may pose, according to a recent report. After a big leap in the number of climate-focused shareholder resolutions in 2014, the total continues to climb in 2015. Investors filed more than 75 resolutions asking for more greenhouse gas emissions accounting and related risk management, up from 66 in 2014. The report, “Proxy Preview 2015,” now in its 11th year and published by the Sustainable Investments Institute, tracks the number and type of environmental and social shareholder resolutions filed and how those resolutions fare with companies in terms of voting and withdrawal rates. Investors typically vote on proxies in April and May.

Investors also are paying more attention to climate-related risks in 2015, with 15 resolutions asking energy companies to report on how climate change and future fossil fuel demand scenarios will impact their businesses, compared to 12 such resolutions in 2014, the report showed.
Events sponsored and cosponsored by the Air & Waste Management Association (A&WMA) are highlighted in bold. For more information, call A&WMA Member Services at 1-800-270-3444 or visit the A&WMA Events Web site: www.awma.org/events.

To add your events to this calendar, send to: Calendar Listings, Air & Waste Management Association, One Gateway Center, 3rd Floor, 420 Fort Duquesne Blvd., Pittsburgh, PA 15222-1435. Calendar listings are published on a space-available basis and should be received by A&WMA’s editorial offices at least three months in advance of publication.

**Special Issue**

**Air Quality and Human Health**

A special grouping of invited papers on the complex interplay among climate change, extreme weather, air pollution, and human health by eminent scientists in the field.

- Health benefits of air pollution abatement policy: Role of the shape of the concentration-response function
  C. Arden Pope III, Maureen Cropper, Jay Coggins, and Aaron Cohen
- Long-term particulate matter exposure:Attributing health effects to individual PM components
  Ronald Wyngaard and Annette Rohr
- Particulate matter components, sources, and health: Systematic approaches to testing effects
  Kate Adams, Daniel Greenbaum, Rashid Shaik, Annemone M. van Erp, and Armistead Russell
- Respiratory hospitalizations in association with fine PM and its components in New York State
  Rena Jones, Christian Hogrefe, Edward Fitzgerald, Syni-An Hwang, Haluk Ozkaynak, Val Garcia, and Shao Lin
- The geographic distribution and economic value of climate change-related ozone health impacts in the United States in 2030
  Neal Fann, Christopher Nolte, Patrick Dolwick, Tanya Spero, Amanda Curry Brown, Sharon Phillips, and Susan Anenberg
- An assessment of air pollutant exposure methods in Mexico City, Mexico
- Impact of smoke from prescribed burning:
  Is it a public health concern?
  Anjali Haikerwal, Fabienne Reisen, Michael Abramson, Carl Meyer, Foy Johnston, and Martine Dennekamp
- The relationship between daily cardiovascular mortality and daily ambient concentrations of particulate pollutants and daily source contributions from coal power plants and smelters in Phoenix, AZ, 1995–1998: A multipollutant approach to acute, time-series air pollution epidemiology
  William Wilson
- Estimation of future PM2.5- and ozone-related mortality over continental United States in a changing climate: An application of high-resolution dynamical downscaling technique
  Jian Sun, Joshua Fu, Kan Huang, and Yang Gao

Listed here are the papers appearing in the May 2015 issue of EM’s sister publication, the Journal of the Air & Waste Management Association. For more information, go to www.tandfonline.com/UAWM.
A&WMA’s 2015 Annual Conference & Exhibition
June 22-25, 2015 | Raleigh Convention Center | Raleigh, NC

TOP 10 reasons to attend ACE 2015

10 A dynamic Keynote Program featuring invited speaker Gina McCarthy, U.S. EPA Administrator, and panelists, Donald R. van der Vaart, Secretary, N.C. Department of Environment and Natural Resources; Cari P. Boyce, Vice President, Environmental and Energy Policy, Duke Energy; and Vickie Patton, General Counsel, Environmental Defense Fund.

9 The most complete environmental program in the industry with over 100 technical sessions, covering topics such as renewable energy, air quality, waste management, compliance, and climate change, plus the 45th Annual A&WMA Critical Review on Air Quality and Climate Connections, a Mini-Symposium on Regulatory Directions, and more.

8 A new condensed schedule with the Keynote and Grand Opening of the Exhibit Hall on Monday afternoon and technical sessions held Tuesday through Thursday.

7 Expanded exhibit with over 100 top companies and organizations displaying products and services for the environmental industry.

6 The Women’s Professional Development Workshop and Luncheon and other Special Events, including the U.S. EPA Technical Tour, Golf Tournament, 5K Run, and so much more.

5 Location, location, location — Visit the spectacular city of Raleigh with convenient access, beautiful surroundings and the influence of the largest concentration of environmental research in the world.

4 Our greenest conference ever in the new LEED-certified convention center and the option to register for Carbon Offset.

3 Professional Development Opportunities for you to learn new skills and receive CEU credit with nine courses offered on Sunday and Monday.

2 Be a part of the global conversation driving the advancement of the industry.

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