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INSIGHT

Wildfire Smoke: Air Quality Concerns and Management

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Wildfire smoke can temporarily degrade air quality and harm human health. Some Members of Congress have expressed concern about wildfire health risks, including potential interactions with COVID-19. This Insight provides background, discusses federal air quality requirements related to wildfires, and identifies wildfire smoke response programs.

Background

The Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to establish minimum national standards for air quality to protect human health and the environment from emissions that pollute ambient (outdoor) air. EPA has set and periodically revised national ambient air quality standards (NAAQS) for six "criteria" air pollutants—ozone, particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide, and lead. Under the CAA, states have primary responsibility for assuring compliance with the standards, and for establishing and incorporating procedures in state implementation plans to attain and maintain the NAAQS.

Wildfire smoke is a complex mixture of air pollutants that can travel long distances. The chemical composition of smoke depends on various factors including burn conditions (e.g., fire temperature), type of biomass burned (e.g., vegetation), and weather-related influences (e.g., wind). Particles (particulate matter) are the principal pollutant of concern from wildfire smoke. Additional pollutants of concern from wildfire smoke include carbon monoxide, hazardous air pollutants, and emissions that contribute to the formation of ground-level ozone.

Particulate matter is a mixture of solid particles and liquid droplets in the atmosphere. Particle size can range from those visible only through high-power microscopes to larger particles (e.g., soot). EPA's National Emissions Inventory (NEI) identifies wildfires as a major contributor of particulate matter (2002-2019 data and 2014 NEI Report), though quantifying the precise contribution remains an active area of research.

Smoke particles are typically very small and can be inhaled deeply into the lungs. Research has linked short-term exposure to fine particles with a range of health effects, including eye irritation, sore throat, coughing, breathing difficulties, worsening of preexisting heart and lung disease, and increased premature

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mortality. While smoke may affect the health of any individual exposed, sensitive populations—children, pregnant women, and the elderly—are more vulnerable to the exposure. Also, studies show wildland firefighters are exposed to particles and other smoke constituents, including carcinogens. Less is known about cumulative and long-term exposure to wildfire smoke.

Air Quality Requirements and Wildfires

Wildfire smoke can temporarily increase ambient levels of particulate matter and other criteria pollutants regulated under the CAA. These increases may be measured by air monitoring stations comprising a national network, which informs determinations about NAAQS compliance. Congress authorized EPA to treat emissions from certain natural events differently than those from anthropogenic sources. The CAA allows EPA to exclude air quality data from regulatory decisions if such data were demonstratively influenced by "exceptional events" such as certain natural events (42 U.S.C. §7619(b)). EPA described conditions under which states and tribes can demonstrate that air quality impacts from wildfires (or prescribed fires) should be excluded from NAAQS compliance determinations.

Wildfire smoke may also affect implementation of CAA visibility requirements. The CAA established a national visibility goal and authorized a regional haze program to protect visibility in national parks and wilderness areas (42 U.S.C. §7491). For more information, see CRS In Focus IF10496, *Protecting Clean Air in National Parks and Wilderness Areas*.

State-level regulations may also apply to wildfire smoke. Many states have developed programs to manage and control smoke from prescribed burns. Smoke management plans seek to minimize smoke entering populated areas, prevent public safety hazards, and maintain CAA compliance.

Wildfire Smoke Response

Wildfire response strategies rely on air quality monitoring, smoke forecasting, and timely communication of air quality conditions and related health risks to the public. Various federal, tribal, state, and local agencies contribute to these tasks.

EPA and other agencies have developed tools to measure air quality conditions and alert the public. For example, EPA manages AirNow, a multiagency website that reports air quality based on monitoring data received on a regular basis from state, local, and federal agencies. AirNow compiles the data in a consistent format and displays it through interactive maps.

AirNow reports air quality information using the Air Quality Index (AQI), a nationally uniform index. EPA calculates the AQI for a criteria pollutant based on the ambient concentration of that pollutant. AQI values range from 0 to 500. The higher the AQI, the greater the level of air pollution. EPA describes AQI values of 100 or lower as satisfactory.

The Interagency Wildland Fire Air Quality Response Program (IWFAQRP) contributes to air quality monitoring and communication. Led by the U.S. Forest Service (USFS), this interagency program "was created to directly assess, communicate, and address risks posed by wildland fire smoke to the public as well as fire personnel." The program has a national cache of smoke monitoring equipment and deploys technical specialists—Air Resource Advisors (ARAs)—during large smoke events. ARAs may provide, install, and operate monitors, develop smoke forecasts, and share information with wildfire response teams, air quality regulators, and the public.

The need for real-time air quality information is critical during wildfire events. The frequency of air quality reporting varies, however, depending on the equipment used. In addition, permanent monitors may

not be located near the areas affected by smoke. While temporary monitors may be deployed, specialists also use computer modeling to estimate pollution levels.

EPA, USFS, other agencies, and stakeholders are exploring emerging technologies to improve air quality monitoring during wildfire events. For example, the AirNow Sensor Data Pilot adds air pollution data from "low-cost sensors" to the Fire and Smoke Map. Federal agencies caution that such data should be considered supplemental to existing resources, given uncertainties about the "precision, accuracy, and reliability" of sensors.

As Congress deliberates on wildfire legislation, it may consider which monitoring strategies effectively inform smoke management and public health responses. Monitoring strategies may include some combination of stationary monitors, mobile sensors, or models. Congress may also consider monitoring costs, which may vary by location, along with public health benefits.

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