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Wildfire Smoke

State Policies for Reducing Indoor Exposure

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Wildfire Smoke: State Policies for Reducing Indoor Exposure

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Executive Summary

Wildfire smoke is a complex mixture of pollutants that can impact communities near and far from the fire. One of the most harmful constituents of wildfire smoke is fine particulate matter, which is linked to respiratory and cardiovascular disease, as well as neurological effects, endocrine disorders, and other adverse health outcomes. People who face increased risks from exposure to wildfire smoke include those with existing respiratory or cardiovascular disease, people who are pregnant, older adults, and children.

During a wildfire smoke episode, people are advised to stay indoors and take steps to reduce smoke inside the building. Fortunately, there are well-established measures that can reduce smoke and allow people to stay inside safely during periods of poor air quality. Alongside federal, tribal, and local partners, states have an important role to play in ensuring that these evidence-based practices are widely implemented both before and during wildfire smoke episodes. In doing so, states will also help protect people from other indoor air risks.

Recent years have seen a marked increase in the adoption of state policies addressing wildfire smoke. To support continued state action, this report discusses a range of policy strategies and highlights examples of recent state policies and programs. As states consider these and other strategies for reducing indoor wildfire smoke exposure, broad consultation with affected communities and other stakeholders is vital to creating an effective and sustainable statewide approach.

Air Filtration is a Key Measure for Reducing Indoor Exposure to Wildfire Smoke and Other Sources of Air Pollution. Proper air filtration has been shown to be an effective method for reducing indoor levels of fine particles. Equipping buildings with adequate filtration will not only help protect people from wildfire smoke but will also reduce risks from other sources of air pollutants and from infectious aerosols. Thus, all states can benefit from establishing policies and programs to improve building filtration. In addition to filtration, air sealing with proper ventilation helps reduce the entry of wildfire smoke and other outdoor pollutants, and measures to ensure safe indoor temperatures allow people to stay indoors during wildfires and heat emergencies.

Stronger State Policies and Programs are Needed to Reduce Exposure to Wildfire Smoke in Homes, Schools, Workplaces, and Other Buildings. In response to the coronavirus pandemic, a number of states and other jurisdictions created policies and programs to improve filtration and ventilation, particularly in schools. There have also been significant new wildfire smoke policies and programs over the past few years, including important laws and regulations in Oregon, Washington, and California. Yet the potential for improving indoor air quality to make buildings healthier and more resilient to wildfire smoke and other indoor air contaminants is largely untapped. Given the potential for long-distance transport of wildfire smoke and the co-benefits of equipping buildings to reduce smoke exposure, states should act swiftly to strengthen their policies and programs. This report discusses several non-regulatory and regulatory strategies for states to consider, highlighting recent examples that reflect a variety of approaches.

Outreach and Education. In order for people to protect themselves from wildfire smoke, they need clear and practical information about health risks, air quality conditions, and evidence-based actions for reducing exposure. Outreach and notification are also needed in advance of and during prescribed burns, so that affected communities can avoid anticipated and unexpected smoke impacts. Recent wildfire smoke policies emphasize outreach and education as core state functions. Local and tribal agencies and organizations are essential partners for state agencies in identifying the types of information needed and communicating that information effectively to ensure it reaches people who are at greatest risk of health effects and who may not be served by current programs. Washington's health agency took the notable step of creating an advisory group focused specifically on supporting local agencies with technical guidance for reducing wildfire smoke exposure.

Cleaner Air Centers. An important government function during a wildfire smoke emergency is ensuring that there are cleaner air centers to provide indoor relief from wildfire smoke. Cleaner air centers make use of existing facilities – often publicly-owned buildings such as libraries or community centers – that are open to the public for portions of the day. They may be integrated with facilities that provide shelter or respite from other emergencies, such as heat waves and power outages. And some agencies and organizations have begun to develop year-round "resilience hubs" that serve multiple community needs in addition to providing relief during emergencies. State financial and technical assistance is important for supporting the local agencies and organizations that set up and operate cleaner air centers. Funds are needed for identifying, equipping, and operating the facilities. Comprehensive written guidance is also needed – on both the technical approaches to reducing indoor smoke levels and the considerations for providing outreach, transportation, and other measures to reduce practical barriers to accessing and using the facilities.

Material Assistance. Another important focus for state policy is providing material assistance to individuals and families to reduce wildfire smoke risks in their homes. During the pandemic, many jurisdictions took advantage of significant federal funding to support ventilation and filtration improvements in schools, child care buildings, and other types of facilities. Those efforts should be sustained and broadened to prepare for future air quality and infectious disease emergencies.

States could develop new programs focused directly on wildfire smoke exposure, as the Oregon legislature did in funding state distribution of air filters and air conditioners. Alternatively, states could expand or leverage existing programs that provide funding for home improvements – e.g., healthy homes, asthma control, energy efficiency, and utility assistance programs. Many states already have such programs in place and could identify how they might be used to provide air filtration, along with related measures like air sealing and cooling, to reduce wildfire smoke and other indoor environmental risks. In addition, states could consider following the example of several jurisdictions that developed innovative Medicaid demonstration projects to provide air filters and other similar devices for patients with medical needs. States could also support tribal and local agencies and organizations that provide residents with the materials and instructions needed to create their own do-it-yourself air filters, which have been shown to be effective in reducing smoke concentrations if used appropriately.

The increase in ambient temperatures and extreme heat events creates an urgent need for policies that advance a sustainable approach to cooling new buildings and provide adequate cooling for existing buildings – especially for lower-income households that lack air conditioning or live in less energy-efficient homes that cost more to cool. Such policies are also important for addressing wildfire smoke

exposure, so that people can safely stay indoors with their windows closed when wildfire smoke episodes occur during periods of high heat.

Regulatory Requirements. Several areas of state regulatory authority are relevant to reducing indoor wildfire smoke exposure in homes, schools, workplaces, and other buildings.

Building codes and other laws governing construction can be developed to ensure that the future building stock is equipped to reduce indoor air risks. Jurisdictions could follow the lead of California and Washington and incorporate a requirement for high-efficiency filtration in the next revision of their building codes. They could also integrate a high-efficiency filtration standard into other state laws and regulations that govern the construction of publicly-funded buildings like schools and affordable housing.

It is also important for state policymakers to consider how to improve air filtration and indoor air quality in *existing* buildings. States could require those who operate rental housing, schools, child care facilities, and workplaces to develop and implement wildfire smoke emergency plans outlining actions to be taken during a smoke emergency, such as providing enhanced filtration through the mechanical system or through portable air cleaners. States could also require facilities to meet a high-efficiency filtration standard or as close to that standard as the mechanical system allows. California recently adopted this type of requirement for existing school facilities, and new rules in Washington require high-efficiency filtration for existing temporary worker housing served by a mechanical ventilation system. Oregon, California, and Washington have taken the important step of establishing workplace wildfire smoke rules that require employers to implement certain measures to reduce exposure, though the rules focus mainly on outdoor workplaces and provide potentially broad exemptions for enclosed buildings.

States Should Ensure that Policies and Programs Reach People at Heightened Risk from Wildfire Smoke Exposure. As the national Wildland Fire Mitigation and Management Commission underscored in its 2023 report, there are "inequities in people's vulnerability to smoke and ability to mitigate its impact that have not received sufficient attention and support." Regulatory requirements for improved filtration and ventilation in buildings are important for reducing inequities in wildfire smoke risks. School facility standards, e.g., can help ensure that all schools throughout a state adequately manage indoor air quality, rather than only schools in higher wealth districts. Rental housing standards and adequate code enforcement can help protect tenants who have limited options for healthy, affordable housing.

Non-regulatory wildfire smoke programs and initiatives should be designed to ensure that they reach people who are at heightened risk from wildfire smoke exposure and those who have been historically underserved by government programs and policies. State outreach and education programs can work with local partners to identify the best way to communicate needed information, and material assistance programs can prioritize households that are most at risk of health impacts and not in a position to implement recommended actions for reducing exposure. Programs that fund cleaner air centers can establish criteria for making facilities easily accessible to those who do not have housing that provides protection from unhealthy air quality.

In addition to integrating environmental justice and health equity goals in wildfire smoke laws and programs, states could establish such goals across agency programs. The Oregon Health Authority, for example, has set a goal of ending health inequities in the state by 2030, and that goal informs implementation of all of the agency's programs.

Collaboration Among Multiple Agencies is Important for Implementing Effective Wildfire Smoke Programs. Given the large number of agencies involved in wildfire smoke planning and response, formal and informal mechanisms for interagency collaboration are essential for implementing programs effectively. In some states, regular coordinating calls with agencies at all levels of government and other stakeholders are the central vehicles for coordinating wildfire preparedness and response actions. Statewide wildfire smoke plans or protocols, updated periodically, can help clarify agency roles and responsibilities. States could also establish policies that facilitate *local* wildfire smoke planning. A California law, e.g., requires counties to establish wildfire smoke air quality plans based on a state model, and recent policies and programs in Oregon support the development of local smoke management plans.

Funding is Needed to Build and Sustain Wildfire Smoke Programs. State wildfire smoke policies should include the funding required to build and sustain state programs to reduce indoor exposures. Stable, long-term funding commitments enable agencies to hire dedicated staff and develop material assistance and outreach programs in a way that best meets local needs. Adequate funding is also essential for providing additional air monitoring equipment in communities that face wildfire smoke risks but are not covered by the existing monitoring network.

In addition to funding for specific wildfire smoke programs, sustained and equitable public health funding is needed to enable communities to address a range of environmental health risks, including wildfire smoke. Oregon and Washington are two states that have enacted legislation in recent years to increase public health funding for the state health agency as well as for local and tribal health agencies and organizations. Such funding provides flexibility for agencies to address multiple risks that may not otherwise have a dedicated founding source.

PART ONE
INTRODUCTION

Wildfires have been increasing in frequency and magnitude, producing smoke that can degrade air quality and damage health in communities near and far from the blaze. The long-distance impacts of wildfire smoke were starkly demonstrated in 2023, as Canadian wildfires caused unhealthy air quality and prompted public health alerts in many states from the Upper Midwest to the East Coast of the United States.

Firefighters and others who work outdoors face significant outdoor exposure to wildfire smoke. For most people, though, exposure occurs primarily indoors. In the U.S., people spend on average about 90 percent of their time indoors, and during wildfire smoke episodes a core public health recommendation is to stay inside and take steps to keep smoke out.

There are well-established practices for limiting wildfire smoke exposure indoors. One of the key measures, and a focus of this report, is to provide adequate filtration of the air inside buildings. Ensuring that buildings have air filtration capable of removing dangerous pollutants not only makes buildings more resilient to future wildfire smoke episodes but also reduces exposure to vehicle and industrial pollution and to contaminants generated inside the building. Enhanced filtration is also recognized as an important strategy for reducing indoor airborne transmission of infectious diseases.

State policies and programs are vital to preparing for and responding to wildfire smoke emergencies and to improving air quality in homes, schools, and other buildings. It is especially important for these measures to be designed and implemented to reach those who are at heightened risk from the serious health effects associated with wildfire smoke exposure.

Wildfire Smoke Across the U.S.

Increasing Wildfires. The Fifth National Climate Assessment identifies climate change – and associated warmer, drier conditions – as a driver of increased wildfire activity.[1] According to the U.S. Environmental Protection Agency (EPA), "[m]ultiple studies have found that climate change has already led to an increase in wildfire season length, wildfire frequency, and burned area."[2] Data from the National Interagency Fire Center show that the 10 years with the largest acreage burned have all occurred since 2004.[3] These trends are predicted to continue: "With continued high emissions of

[1] U.S. Global Change Research Program, Fifth National Climate Assessment: Focus on Western Wildfires (2023). See also D. Jaffe, et al., Wildfire and Prescribed Burning Impacts on Air Quality in the United States, J. of the Air & Waste Mgmt. Assoc., Vol. 70, No. 6, 583–615, 585 (2020).
[2] U.S. EPA, Climate Change Indicators: Wildfires.
[3] See U.S. EPA, Climate Change Indicators: Wildfires; Natl. Interagency Fire Center, Wildfires and Acres. One recent study found that catastrophic wildfires in the U.S. have increased from an average of 1.5 per decade from 1980-1999 to seven per decade from 2000-2019. S. Masri, et al., Disproportionate Impacts of Wildfires among Elderly and Low-Income Communities in California from 2000–2020, Int. J. Environ. Res. Public Health 18(8), 3921 (2021). See also World

greenhouse gases, models project that the risk of very large wildfires will increase by up to six-fold in parts of the United States by mid-century."[4]

Western states, in particular, have seen a dramatic increase in wildfires, with fires in recent decades becoming "larger, hotter, and more destructive and deadly."[5] The number of acres burned in the West "has increased noticeably in nearly every month of the year,"[6] and since the 1970s, the length of the wildfire season has increased from five months to over seven months in western states.[7] Wildfires occur in other regions as well, particularly the southeastern U.S.[8] Late 2023 saw fires burning "across a broad region, including at least 80 in West Virginia, 60 in Kentucky and dozens in Tennessee, Virginia, North Carolina and Georgia."[9]

Increasing Smoke Near and Far from Wildfires. As industrial pollution has been declining in the U.S., smoke from fires has become a more prominent contributor to air pollution. According to EPA, "[w]ildland fires – including both wildfires and prescribed fires – account for over 30 percent of the nation's primary emissions of fine particulate matter ($PM_{2.5}$)."[10] A 2023 report by the national Wildland Fire Mitigation and Management Commission states that, alongside projected increases in the size, frequency and severity of wildfires, "smoke levels are similarly expected to increase, chipping away at what had been steady improvements in the country's air quality over the past several decades."[11] A recent study found that the "number of people in locations with at least 1 day of smoke $PM_{2.5}$ above 100μg/m^3 per year has increased 27-fold over the last decade."[12] An analysis of wildfire trends in Oregon concluded that since 2012 there have been more days at "unhealthy" or worse air quality levels, and the

Resources Inst., New Data Confirms: Forest Fires Are Getting Worse (noting that fires are becoming more widespread globally, "burning nearly twice as much tree cover today as they did 20 years ago").

[4] Natl. Oceanic and Atmos. Admin., Wildfire Climate Connection. See also S. D'Evelyn, et al., Wildfire, Smoke Exposure, Human Health, and Environmental Justice Need to be Integrated into Forest Restoration and Management, Current Envtl. Health Report, Vol. 9, 366-3859, 366–385, 369 (2022) ("Regional fire events across the western US are expected to increase even under the most optimistic climatic scenarios.").

[5] U.S. Global Change Research Program, Fifth National Climate Assessment: Focus on Western Wildfires (2023). See also S. Masri, et al., Disproportionate Impacts of Wildfires among Elderly and Low-Income Communities in California from 2000–2020, Int. J. Environ. Res. Public Health 18(8), 3921 (2021) (describing a "historic increase" in wildfire activity in the northwest); S. D'Evelyn, et al., Wildfire, Smoke Exposure, Human Health, and Environmental Justice Need to be Integrated into Forest Restoration and Management, Current Envtl. Health Report, Vol. 9, 366-385, 369 (2022) ("In 2020 alone, over 4.1 million (hectares) burned during summer wildfires in Washington, Oregon, and California.").

[6] U.S. EPA, Climate Change Indicators: Wildfires.

[7] U.S. Dept. of Agriculture, Wildfire.

[8] See D. Jaffe, et al., Wildfire and Prescribed Burning Impacts on Air Quality in the United States, J. of the Air & Waste Mgmt. Assoc., Vol. 70, No. 6, 583–615, 586 (2020) (in Nov. 2016, "large wildland fires burned in Tennessee, North Carolina, South Carolina, and Georgia, generating $PM_{2.5}$ concentrations exceeding 100 μg/m3 in many cities" for weeks).

[9] I. Livingston, "Hundreds of Fires are Burning in the Appalachians Amid Growing Drought," Wash. Post (11/9/23).

[10] U.S. EPA, Fact Sheet: Notice of Proposed Rulemaking for the EPA Reconsideration of the National Ambient Air Quality Standards for Particulate Matter; 88 Fed. Reg. 5558, 5569 (Reconsideration of the National Ambient Air Quality Standards for Particulate Matter) (1/27/23).

[11] Wildland Fire Mitigation and Management Commission, On Fire: The Report of the Wildland Fire Mitigation and Management Commission at 9 (2023). See also C. McClure & D. Jaffe, US Particulate Matter Air Quality Improves Except in Wildfire-Prone Areas, 115 Proc. Natl. Acad. Sci. 7901 (2018) (attributing increase in $PM_{2.5}$ in the Northwest to wildfires).

[12] M. Childs, et al., Daily Local-Level Estimates of Ambient Wildfire Smoke $PM_{2.5}$ for the Contiguous US, Environ. Sci. Technol. 56, 19, 13607–13621 (2022).

state "should expect to see an increasing number of [such days] during the summer, and not just in Southern Oregon where it is more common, but across the state."[13]

Wildfire smoke can be transported thousands of miles and affect communities far from the fire.[14] A recent assessment of the distribution of health impacts from smoke exposure in the U.S. from 2006 to 2018 found that "[a]lthough the majority of large landscape fires occur in the western US…the majority of mortality (74%) and asthma morbidity (on average 75% across 2006-2018) attributable to smoke $PM_{2.5}$ occurs outside the West, due to higher population density in the East."[15] A 2023 analysis of air pollution data found that "since at least 2016, wildfire smoke has influenced trends in average annual $PM_{2.5}$ concentrations in nearly three-quarters of states in the contiguous" United States.[16]

The Canadian wildfires of 2023 provided a case study in the long-range impacts of wildfire smoke. On June 7, New York City recorded the worst air quality in the world.[17] On June 28, the Chicago skyline was "shrouded in whitish, smokey clouds," while Cleveland residents "could taste the smoke in the air."[18] A few weeks later, "nearly 70 million people in 32 states and the District of Columbia were affected by the shifting, migrating smoke," with air quality alerts ranging from "moderate" to "very unhealthy" issued by "government agencies from Montana to the Dakotas and parts of other states, including Nebraska, Alabama, Tennessee, Ohio, North Carolina, and along the Northeast."[19] Even months later, on October 3, much of Florida was in the unhealthy range for air quality due to smoke from the Canadian wildfires.[20] A study using model simulations published in late 2023 found that "almost the whole of the northern hemisphere was subject to marked significant declines in air quality due to long-range wind transport of pollutants" from the Canadian wildfires.[21]

Smoke from Prescribed Fires. This report focuses on smoke from wildfires, but communities may be affected by smoke from nearby prescribed fires (also called prescribed burns) as well. EPA regulations define prescribed fire as "any fire intentionally ignited by management actions in accordance with applicable laws, policies, and regulations to meet specific land or resource management objectives." 40 Code Fed. Regs. (C.F.R.) §50.1(m). A recent California report defined prescribed burns as "the planned

[13] Oregon Dept. of Env. Quality, Wildfire Smoke Trends Report (May 2023). The $PM_{2.5}$ thresholds for Air Quality Index categories ("unhealthy for sensitive groups," "unhealthy," etc.) could be lowered in the near future, as EPA has proposed lowering the annual $PM_{2.5}$ standard and has taken comments on lowering the 24-hour standard. See U.S. EPA, Proposed Revisions to the NAAQS for Particulate Matter (Jan. 2023).

[14] U.S. Global Change Research Program, Fifth National Climate Assessment: Focus on Western Wildfires (2023); U.S. Global Change Research Program, The Fifth National Climate Assessment ("wildfire in one region can affect air quality and human health in other regions, depending on where winds transport smoke").

[15] K. O'Dell, et al., Estimated Mortality and Morbidity Attributable to Smoke Plumes in the United States: Not Just a Western US Problem, GeoHealth, Vol. 5, Issue 9 at 1 (also finding that northwestern and Great Plains states have higher percentages of mortality attributable to smoke $PM_{2.5}$).

[16] M. Burke, et al., The Contribution of Wildfire to $PM_{2.5}$ Trends in the USA, Nature 622, 761–766 (2023). See also M. Burke, et al., The Changing Risk and Burden of Wildfire in the United States, Proc. Natl. Acad. Of Sciences, Vol. 118, No. 2 (Jan. 2021).

[17] E. Newburger, "New York City Tops World's Worst Air Pollution List from Canada Wildfire Smoke," CNBC (6/7/23).

[18] J. Brosman, "Smoky Skies Menace U.S. Cities, Driving Residents Indoors," N.Y. Times (6/28/23).

[19] C. Hauser and C. Moses, "Smoke Pollution from Canadian Wildfires Blankets U.S. Cities, Again," N.Y. Times (7/18/23).

[20] "Canadian Wildfire Smoke Brings Hazy Sky Across Florida," The News-Press (10/3/2023).

[21] Z. Wang, et al., Severe Global Environmental Issues Caused by Canada's Record-Breaking Wildfires in 2023, Adv. Atmos. Sci. (Nov. 2023).

and controlled application of fire to the land, under specified, low-risk weather conditions. [They] may be conducted not only to help prevent high-intensity wildland fires by reducing the quantity and continuity of wildland fuel, but to achieve other benefits, such as promoting forest ecological health, improving wildlife habitat, watershed management and range improvement."[22] To achieve these goals, prescribed burning allows lower levels of smoke as a tradeoff for reducing the likelihood of severe smoke episodes from large wildfires.

Federal and state policies have begun to place greater emphasis on the use of prescribed burning. In November 2023, four federal agencies signed a Memorandum of Understanding titled Wildfire and Air Quality Coordination, committing to "work together to achieve the mutually important objectives of protecting public health from the impacts of smoke and enabling land management practices that reduce the future risk of large, high severity fire events."[23] The U.S. Departments of Interior and Agriculture have adopted plans outlining their strategies for reducing fuel loads on federal lands at high risk of wildfire.[24] The Infrastructure Investment and Jobs Act of 2021 (Bipartisan Infrastructure Law) provided "unprecedented" funding of $500 million to these two agencies for prescribed fire planning and implementation.[25] In a 2023 report on the use of prescribed fire, the national Wildland Fire Mitigation and Management Commission stated: "Policy change is needed to enable a new relationship with fire, one in which fire is no longer an existential risk to communities and landscapes, but instead an integral and beneficial component of our human and natural systems."[26]

Oregon, Washington, California, Utah, and other states have recently established policies to increase flexibility for allowing prescribed burns while minimizing smoke impacts.[27] A survey of prescribed fire activity in 2020 found that the "Southeast region continues to lead the nation in annual acres treated with prescribed fire, followed by the West and Northeast-Midwest."[28]

Although prescribed burns are generally smaller and produce less smoke than wildfires, "[a]ll forms of smoke, whether from fire that is planned or unplanned, can negatively impact human health."[29] EPA's

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[22] Cal. Dept. of Public Health, Public Health Impact of Prescribed Fire: Report on Listening Sessions with Community Members, El Dorado and Nevada Counties, California at 9 (2021).
[23] U.S. Dept. of Agriculture, U.S. Dept. of Interior, U.S. EPA, & U.S. Centers for Disease Control & Prevention, 2023 Wildland Fire and Air Quality MOU at 3.
[24] See U.S. Dept. of the Interior, Wildfire Risk Five-Year Monitoring, Maintenance, and Treatment Plan (2022); U.S. Forest Svc., Confronting the Wildfire Crisis (2022). The National Cohesive Wildland Fire Management Strategy was updated in 2023. See Wildland Fire Leadership Council, National Cohesive Wildland Fire Management Strategy Addendum Update (Jan. 2023).
[25] Wildland Fire Mitigation and Management Commission, On Fire: The Report of the Wildland Fire Mitigation and Management Commission at 96, 259 (2023).
[26] Wildland Fire Mitigation and Management Commission, On Fire: The Report of the Wildland Fire Mitigation and Management Commission at 3 (2023).
[27] See Or. Dept. of Entl. Quality, SIP Elements for the Oregon Smoke Management Plan Rulemaking and Plan Update (2019); Or. Admin. Rules §629-048-0020; Wash. Dept. of Ecology, State Implementation Plan Revision Including Washington State Department of Natural Resource's 2022 Smoke Management Plan (2022); Cal. Dept. of Public Health, Public Health Impact of Prescribed Fire at 8 (2021); Cal. Pub. Res. Code §4771(c)(1)(D); State of Utah, Utah Smoke Management Plan (rev. 2021).
[28] Natl. Assoc. of State Foresters, 2021 National Prescribed Fire Use Survey Report at 7 (2021).
[29] Wildland Fire Mitigation and Management Commission, On Fire: The Report of the Wildland Fire Mitigation and Management Commission at 83 (2023).

2019 scientific review of fine particulate matter found that the evidence indicates there is no exposure threshold below which health effects are not observed.[30] Moreover, repeated prescribed burns may be more likely to impact communities with socio-demographic and health vulnerabilities.[31] A recent study of prescribed burning in the state of Georgia found that "areas with intense prescribed fire have levels of social vulnerability that are over 25% higher than the state average" and that the health impacts of prescribed fire are "concentrated in areas with higher fractions of low socioeconomic status, elderly, and disabled residents, particularly vulnerable to air pollution."[32]

The national Wildland Fire Mitigation and Management Commission's 2023 report identified "a need to increase beneficial fire, and, at the same time…reduce the impact of smoke on humans."[33] Because prescribed fires are planned, steps can be taken to minimize smoke risks. State smoke management rules, plans, and programs need to incorporate clear requirements and practices to ensure that the prescribed burn approval process effectively prevents smoke from endangering communities, that communities are notified of smoke risks, and that agencies respond promptly to unexpected smoke impacts. Comprehensive review of evolving smoke management policies and programs is outside the scope of this report but is an important subject for further study.

Health Risks of Wildfire Smoke Exposure

Wildfire smoke is made up of "thousands of individual compounds, including particulate matter, carbon dioxide, water vapor, carbon monoxide, hydrocarbons and other organic chemicals, nitrogen oxides, and trace minerals."[34] In addition, various chemical substances may be released into the air when wildfires burn structures and other materials, and pollutants emitted directly from wildfires may undergo reactions in the atmosphere and form secondary pollutants, such as ozone.[35] A California Air Resources Board analysis showed that smoke from the 2021 Camp Fire "exposed Californians to dangerous levels of particulate matter and contained concerning levels of toxic metal contaminants, including lead…"[36]

Health Risks of Particulate Matter. While many constituents of smoke are associated with adverse health effects, the central pollutant of concern is particulate matter (PM), a complex mixture of small, solid particles and liquid droplets.[37] Particulate matter may be composed of many different individual substances, including acids (e.g., nitrates and sulfates), organic chemicals, metals, soil or dust

[30] U.S. EPA, Integrated Science Assessment (ISA) for Particulate Matter (Final Report, Dec 2019) at ES-23 ("Evidence continues to support a linear, no-threshold concentration—response relationship, but with less certainty in the shape of the curve at lower concentrations (i.e., below about 8 µg/m3)."
[31] S. D'Evelyn, et al., Wildfire, Smoke Exposure, Human Health, and Environmental Justice Need to be Integrated into Forest Restoration and Management, Current Envtl. Health Report, Vol. 9, 366-385, 371 (2022). See also J. Sacks, et al., At the Intersection: Protecting Public Health from Smoke While Addressing the U.S. Wildfire Crisis, Am. J. Respir. Crit. Care Med., Vol. 208, No. 7 at 755 (10/1/23).
[32] S. Afrin & F. Garcia-Menendez, Potential Impacts of Prescribed Fire Smoke on Public Health and Socially Vulnerable Populations in a Southeastern U.S. State, Sci. Total Environ. (2021).
[33] Id. at 95.
[34] U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 1 (rev. 2021).
[35] Id. at 4, 6.
[36] Cal. Air Resources Bd., New Analysis Shows Spikes of Metal Contaminants…in 2018 Camp Fire Wildfire Smoke (2021).
[37] U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 12 (rev. 2021).

particles, and allergens (e.g., mold spores or pollen).[38] The fine particles ($PM_{2.5}$) in wildfire smoke, when inhaled, can penetrate deep into the lungs and may also enter the bloodstream.[39]

According to EPA, numerous scientific studies have linked particle pollution exposure to a variety of respiratory and cardiovascular problems, including:[40]

- premature death in people with heart or lung disease
- nonfatal heart attacks
- irregular heartbeat
- aggravated asthma
- decreased lung function
- respiratory symptoms (e.g., airway irritation, coughing, difficulty breathing)

The American Lung Association's summary of the scientific literature echoes these findings and notes that there has also been research linking year-round particle pollution exposure to, among other things, "neurological effects in adults including reduced brain volume, cognitive decrements and dementia," a "higher likelihood of getting lung cancer," and impacts on "pregnancy and birth outcomes, such as preterm birth, low birth weight and fetal and infant mortality."[41] The National Academies of Science and Engineering (National Academies or NASEM) recently noted "overwhelming evidence…that exposure to $PM_{2.5}$ of outdoor origin is associated with a range of adverse health effects, including cardiovascular, pulmonary, neurological and psychiatric, and endocrine disorders as well as poor birth outcomes…"[42]

Health Risks of Wildfire Smoke. In addition to the substantial body of research on particulate matter health effects, there has been a significant increase in studies linking adverse health effects specifically to wildfire smoke.[43] According to EPA, recent studies on wildfire smoke show evidence of "health effects consistent with those reported for particulate matter."[44] A 2022 U.S. government scientific assessment of wildfire smoke summarized the research this way:

> Studies of wildland fire smoke report consistent evidence of a positive association with respiratory effects such as asthma and COPD exacerbations…A growing body of research is providing consistent evidence of links between wildfire smoke, specifically wildfire specific

[38] U.S. EPA, Particle Pollution and Your Health (2003).
[39] U.S. EPA, Health and Environmental Effects of Particulate Matter (PM). Fine particles are those with a diameter of 2.5 micrometers and smaller. U.S. EPA, Particulate Matter ($PM_{2.5}$) Trends.
[40] U.S. EPA, Health and Environmental Effects of Particulate Matter (PM).
[41] American Lung Assoc., Particle Pollution (rev. Sept. 2023).
[42] Natl. Acad. of Sci. and Eng. (NASEM), Health Risks of Indoor Exposure to Fine Particulate Matter and Practical Mitigation Solutions at 1 (2024). In 2023, NASEM convened experts to review recent literature on the health effects from *indoor* exposure to particulate matter and concluded that "there is strong evidence that exposure to indoor $PM_{2.5}$ has adverse effects on the respiratory and cardiovascular systems and likely other organ systems." Id. at 160.
[43] U.S. EPA, Comparative Assessment of the Impacts of Prescribed Fire Versus Wildfire (CAIF): A Case Study in the Western U.S. at 6-2 (2021). See also U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 4 (rev. 2021). Some studies have suggested that wildfire smoke is more harmful than particulate matter from other sources. See, e.g., R. Aguilera, et al., Wildfire Smoke Impacts Respiratory Health More than Fine Particles from Other Sources: Observational Evidence from Southern California, Nature Communications, Vol. 12, No. 1493 (2021); J. Coco-Liu, et. al., Wildfire-specific Fine Particulate Matter and Risk of Hospital Admissions in Urban and Rural Counties, Epidemiology, Vol. 28(1): 77–85 (2017).
[44] U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 1 (updated 2021). See also U.S. EPA, Wildland Fire Research: Health Effects Research (describing current health research).

$PM_{2.5}$ exposure and adverse cardiovascular impacts, including ischemic heart disease, cardiac arrhythmia, and heart failure.[45]

A Washington State report found that wildfire smoke "was associated with an increase in medical claims for asthma for 10 days after exposure, and an increase in emergency department (ED) claims on the day of exposure" and that "these totals underestimate the full burden in Washington."[46] After millions of people in the U.S. were exposed to wildfire smoke from the 2023 Canadian fires, a team of researchers from the U.S. Centers for Disease Control and Prevention (CDC) found "significant increases in asthma-associated" emergency room visits.[47]

Studies have "identified an association between wildfire smoke and adverse pregnancy and birth outcomes, namely preterm birth and low birthweight…potentially through both the effect of exposure to wildfire smoke and maternal stress associated with wildfire occurrence."[48] Wildfire smoke exposure may also adversely affect mental and behavioral health.[49]

Increased Health Risks and Disparities. Many people face greater health risks from exposure to wildfire smoke, including:[50]

- people with asthma and other respiratory diseases
- people with cardiovascular diseases
- babies and children
- pregnant people
- older adults
- people with low socioeconomic status
- people who live in areas with high baseline air pollution
- outdoor workers

People with asthma are at higher risk from exposure to wildfire smoke, and the burden of that disease falls disproportionately on people of color and low-income children and adults.[51] A 2020 report from the Asthma and Allergy Foundation of America found that "[n]early 25 million people in the United States are living with asthma, but prevalence rates differ significantly by race and ethnicity" and "the burden of

[45] U.S. Forest Services, Wildland Fire Smoke in the United States: A Scientific Assessment at 226 (2022). See also S. D'Evelyn, et al., Wildfire, Smoke Exposure, Human Health, and Environmental Justice Need to be Integrated into Forest Restoration and Management, Current Envtl. Health Report, Vol. 9, 366-385, 371 (2022).
[46] Wash. Office of Financial Mgmt., Increased Medical and Emergency Department Claims for Asthma After Wildfire Smoke Exposure in Washington, 2015-2018.
[47] C. McArdle, et al., Asthma-Associated Emergency Department Visits During the Canadian Wildfire Smoke Episodes — United States, April– August 2023, MMWR Weekly, 72:926–932 (8/25/23). See also H. Meek, et al., Notes from the Field: Asthma-Associated Emergency Department Visits During a Wildfire Smoke Event — New York, June 2023, MMWR Weekly, 72:933–935 (8/25/23).
[48] C. Gould, et al., Health Effects of Wildfire Smoke Exposure, Ann. Rev. Med. 2024, 75:19.1–19.16 (Adv. Rev. Sept 2023). See also U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 8 (rev. 2021).
[49] See Wash. Dept. of Health, Smoke From Fires FAQ; U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 4, 43 (rev. 2021); D. Eisenman & L. Galway, The Mental Health and Well-Being Effects of Wildfire Smoke: A Scoping Review; BMC Public Health 22, 2274 (2022). M. Mirabelli, et al., Wildfire Smoke and Symptoms Affecting Mental Health Among Adults in the U.S. State of Oregon, Preventive Medicine, Vol. 164 (Nov. 2022).
[50] U.S. EPA, Which Populations Experience Greater Risks of Adverse Health Effects Resulting from Wildfire Smoke Exposure?; U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 6-9 (rev. 2021); CDC, Protect Yourself from Wildfire Smoke.
[51] See U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 9 (rev. 2021).

asthma falls disproportionately on Black, Hispanic and American Indian and Alaska Native populations."[52] A study of asthma impacts from recent wildfire smoke events cautioned that "extreme weather events might worsen [existing asthma] health inequities."[53]

A 2023 report by the Washington Department of Ecology found disparities in exposure to air pollution and resulting health effects within the state. According to the agency, between 2020 and 2022, "overburdened communities highly impacted by air pollution experienced an average of 7.5 days per year with air quality that were unhealthy for sensitive groups, or worse" compared to the statewide average of 6.7 days, and that "[m]ost of the unhealthy air quality days occurred during wildfire smoke events." The report also found that people in "overburdened communities highly impacted by air pollution have more health problems, including lung and heart disease, compared to the average for the state," and they live 2.4 years less than people in the rest of the state, on average. The report identified 16 such communities throughout the state, and found that people of color and people with low incomes are disproportionately represented in those areas.[54]

Health risks from particulate matter exposure generally and wildfire smoke specifically are also linked to socioeconomic factors.[55] A 2012 analysis of health effects following an episode of acute exposure to wildfire smoke found that "among various measures of health, Socio-Economic Factors played the most important role in defining susceptibility at the community level."[56] A study of two population centers in California during the 2020 fire season found that higher $PM_{2.5}$ concentrations "were positively correlated with poverty, cardiovascular emergency department visits, and housing inequities," and thus "[w]ildfire may exacerbate health disparities [and] environmental justice concerns."[57]

People with limited financial resources are more likely to be without housing, to live in housing that provides inadequate protection from wildfire smoke, and to have less access to air cleaners and other

[52] Asthma and Allergy Fndn. of Amer., Asthma Disparities in America: A Roadmap to Reducing Burden on Racial and Ethnic Minorities at 9-14 (2020). See also U.S. Dept. of Health & Human Svcs., Asthma and African-Americans.
[53] See H. Meek, et al., Notes from the Field: Asthma-Associated Emergency Department Visits During a Wildfire Smoke Event — New York, June 2023, MMWR Weekly, 72:933–935 (2023).
[54] Wash. Dept. of Ecology, Improving Air Quality in Overburdened Communities Highly Impacted by Air Pollution at 19, 49 (Dec. 2023). The report's analysis did not include Tribal communities.
[55] See U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 9 (rev. 2021); Amer. Lung Assoc., Disparities in the Impact of Air Pollution ("Low socioeconomic status consistently increased the risk of premature death from fine particle pollution among 13.2 million Medicare recipients…"); Natl. Academies of Science and Engineering (NASEM), Health Risks of Indoor Exposure to Fine Particulate Matter and Practical Mitigation Solutions at 1 (2024) (concluding that the burden of health effects from $PM_{2.5}$ exposure falls "more heavily on underserved and marginalized communities").
[56] A. Rappold, et al., Cardio-Respiratory Outcomes Associated with Exposure to Wildfire Smoke are Modified by Measures of Community Health, Environmental Health, Vol. 11, Art: 71 (2012).
[57] A. Kramer, et al., Environmental Justice Analysis of Wildfire-Related $PM_{2.5}$ Exposure using Low-Cost Sensors in California, Science of The Total Envt., Vol. 856, Part 2, 159218 (Jan. 2023).

equipment for reducing exposure.[58] School facilities in low-wealth communities are more likely have inadequate ventilation and other indoor air quality problems.[59]

Technical Best Practices for Reducing Indoor Smoke Exposure

Staying indoors is a top-line recommendation during wildfire smoke events. But as the California Department of Public Health has advised, the "value of staying indoors to avoid wildfire smoke exposure depends on how well the home or commercial building prevents infiltration of outdoor smoke coupled with the ability to maintain acceptable temperature and air quality…"[60]

Fortunately, there are well-established technical measures for reducing the amount of wildfire smoke inside a building. EPA outlines the principal measures for limiting exposure at home during a wildfire smoke episode, including:

- Keep windows and doors closed.
- Use fans and air conditioning to stay cool.
- Reduce the entry of smoke by, e.g., closing dampers on HVAC systems and air conditioners.
- Use high-efficiency HVAC filters or portable air cleaners to remove fine particles from the air.
- Avoid activities (such as vacuuming or cooking) that create more fine particles indoors.
- Create a clean room.
- Have a supply of N95 respirators on hand.[61]

EPA has published a widely-referenced guidance document, Wildfire Smoke: A Guide for Public Health Officials (referred to here as the Wildfire Smoke Guide), that discusses how to implement these measures.[62] Many agencies and organizations have developed materials to communicate the practices to the public. For example, the Okanogan Clean Air coalition has created a smoke-ready checklist that distills the key recommendations to assist community members in preparing for smoke episodes: create a clean room with an indoor air cleaning system, know how to get air quality information, have a plan for vulnerable household members, consider ideas for staying mentally strong and engaged, and have N95 masks on hand.[63]

For commercial buildings, schools, and multifamily residential buildings, ASHRAE has developed the Planning Framework for Protecting Commercial Building Occupants from Smoke During Wildfire Events.[64]

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[58] CDC, Healthy People 2030: Quality of Housing; U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 9 (rev. 2021); NASEM, Health Risks of Indoor Exposure to Fine Particulate Matter and Practical Mitigation Solutions at 24, 218 (2024). See Harvard Univ. Joint Ctr. for Hsg. Studies, Greater Assistance Needed to Combat the Persistence of Substandard Housing (2023) (housing data shows "households with lower incomes are the most likely to live in inadequate housing").
[59] See. e.g., 21st Century School Fund, Inc., et al., 2021 State of Our Schools at 13, 38-40 (2021) (finding that "Hispanic/Latino, African American, and Native American students are represented disproportionately in high poverty districts, where the schools (on average) have had the lowest levels of investment").
[60] Cal. Dept. of Public Health, Wildfire Smoke: Considerations for California's Public Health Officials at 30 (rev. 2022).
[61] U.S. EPA, Wildfires and Indoor Air Quality (IAQ).
[62] U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 17-25, App. B (rev. 2021). See also Cal. Dept. of Public Health, Wildfire Smoke: Considerations for California's Public Health Officials at 29-41 (rev. 2022).
[63] Okanogan Clean Air, Smoke Ready Checklist.
[64] ASHRAE, Planning Framework for Protecting Commercial Building Occupants from Smoke During Wildfire Events. See also U.S. EPA, Wildfires and Indoor Air Quality in Schools and Commercial Buildings.

The Planning Framework identifies 10 actions that should be part of a written, building-specific smoke readiness plan, many of which are to be taken in advance of fire season, including: purchasing materials and supplies (including filters and low-cost air monitors), assessing HVAC systems' ability to handle high-efficiency filters and estimating when filters will need to be changed, performing HVAC maintenance and airflow optimization, and weatherizing the building envelope. During smoke events, the Planning Framework suggests using additional filtration, taking steps to limit smoke intrusion and other sources of indoor $PM_{2.5}$ emissions, conducting indoor $PM_{2.5}$ monitoring, and creating temporary cleaner air spaces using portable air cleaners with HEPA filters.[65]

Building on this framework, ASHRAE is developing a new wildfire smoke guideline that will cover commercial buildings, institutional buildings, and multifamily residential buildings, including "buildings expected to be occupied by potentially susceptible populations, including children and the elderly." The guideline will address "design, installation, commissioning, operation, and maintenance of building envelope, ventilation, and air cleaning systems" to protect building occupants from smoke exposure.[66] In Fall 2023, ASHRAE issued for public review Proposed Guideline 44P: Protecting Building Occupants from Smoke During Wildfire and Prescribed Burn Events.[67] Guideline 44 is expected to be finalized in 2024.

The rest of this section describes the use of high-efficiency filtration, a key measure for reducing indoor exposure to wildfire smoke *and* other indoor air contaminants. A 2018 EPA review found that "[i]ntervention studies of air cleaners operating in homes have consistently found statistically significant reductions in indoor exposures to indoor $PM_{2.5}$, PM_{10}, and/or particle number counts with the use of portable air cleaners."[68] A 2020 literature review by CDC scientists found that "proper air filtration is an effective method of reducing certain wildfire smoke pollutants indoors and potentially limiting the risk of negative health impacts associated with wildfire smoke."[69] High-efficiency filtration can be provided as part of HVAC equipment (in-duct filters) or through separate air cleaning devices.

In-Duct Filtration. A common method for filtering particles from the air is the use of fibrous filters in mechanical HVAC systems.[70] In mechanical systems that supply air to a space, filters can remove particles from the outside air entering the building and from the recirculated indoor air that goes through the system. Thus, filters work only while HVAC systems are running and moving air through the filters. During a wildfire smoke event, central air systems should be set on "recirculate" mode and operated continuously.[71] For the filters to perform well, they must fit properly in the filter cabinet (to prevent air from bypassing the filter), and they must be replaced regularly.[72]

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[65] ASHRAE, Planning Framework for Protecting Commercial Building Occupants from Smoke During Wildfire Events.
[66] ASHRAE, Titles, Purposes, and Scopes - GPC 44P - Proposed Guideline, Protecting Building Occupants from Smoke During Wildfire and Prescribed Burn Events (2023).
[67] ASHRAE, ASHRAE Journal Podcast Episode 28.
[68] U.S. EPA, Residential Air Cleaners: A Technical Summary at 7 (3rd ed. 2018).
[69] G. Joseph, et al., Evidence on the Use of Indoor Air Filtration as an Intervention for Wildfire Smoke Pollutant Exposure: A Summary for Health Departments at 1 (2020). See also U.S. EPA, Comparative Assessment of the Impacts of Prescribed Fire Versus Wildfire (CAIF): A Case Study in the Western U.S. at 6-27--6-29 (2021) (reviewing studies on effectiveness of HVAC filters and portable air cleaners generally and for wildfire smoke).
[70] For an overview of air cleaning technologies for removing particles and gases, see U.S. EPA, Residential Air Cleaners: A Technical Summary at 14 (3rd ed. 2018).
[71] U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 20 (rev. 2021).
[72] Id.; see also CDC, Ventilation in Buildings (rev. June 2021).

A key factor affecting filter performance is the efficiency rating of the filter. The most commonly used system in the U.S. for rating filter efficiency is the minimum efficiency reporting value (MERV) system, calculated according to ANSI/ASHRAE Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. This procedure rates filters from MERV 1 to MERV 16; the higher the MERV rating, the higher the removal efficiency.[73] MERV 13 filters are rated to capture at least half of particles in the 0.3–1 micron (µm) size range, 85 percent of particles that are 1–3 µm, and 90 percent of particles that are 3–10 µm. ASHRAE 52.2-2017, Table 12-1. The EPA Wildfire Smoke Guide recommends installing pleated filters rated MERV 13 or higher in central air systems where feasible, stressing that filters should be upgraded when wildfire risk rises, before smoke arrives in the area.[74]

An important consideration for increasing filter efficiency in existing mechanical systems is whether the system can handle the new filter. As ASHRAE points out, "[m]any existing HVAC systems were designed and installed to operate using MERV 6 to MERV 8 filters."[75] Nevertheless, in "many commercial buildings and homes, filter system improvements will be simple to implement," and "higher efficiency filters can directly replace existing lower efficiency filters in air handling systems without problems.[76] Research by the California Energy Commission found that "MERV 13 filters are available that can "maximize filtration performance and capture of small particulates while having a minimal impact on pressure drop relative to current MERV 6 and MERV 8 filters."[77]

EPA's Wildfire Smoke Guide and other guidance documents generally recommend that building owners and managers consult with either the system manufacturer or an HVAC technician "to confirm if or which high-efficiency filters will work with an individual system."[78] ASHRAE guidance also offers a series of "practical steps an owner can take to evaluate the maximum MERV rating an HVAC system can accommodate while maintaining acceptable system performance."[79]

Some HVAC filters are designed to remove certain gaseous pollutants in addition to removing particles. The addition of activated carbon to a filter can, e.g., "potentially remove most hydrocarbons, ozone, aldehydes, and organic acids, but is not effective against oxides like sulfur, nitrogen oxide, and ammonia."[80] These filters may also be found in portable air cleaners.

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[73] See U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 20, Table 12-1 (rev. 2021). The MERV rating procedure tests performance in three particle size ranges. MERV 13 filters are rated to capture at least half of particles in the 0.3–1 micron (µm) size range, 85 percent of particles that are 1–3 µm, and 90 percent of particles that are 3–10 µm.
[74] Id. at 19-20.
[75] ASHRAE/ASHRAE Epidemic Task Force, Building Readiness at 36 (rev. May 2022).
[76] Lawrence Berkeley Natl. Lab., National Benefits of Improved Particle Filtration.
[77] Cal. Energy Comm., 2019 Energy Code Initial Statement of Reasons at 135 (2018). See also Wash. Dept. of Health, Improving Indoor Air Quality During Wildfire Smoke Events at 2 (2022) (noting that "most public HVAC systems should accommodate the recommended MERV 13 filters").
[78] See U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 20 (rev. 2021); Wash. Dept. of Health, Improving Indoor Air Quality During Wildfire Smoke Events at 2 (June 2022).
[79] ASHRAE/ASHRAE Epidemic Task Force, Building Readiness at 45-47 (rev. May 2022).
[80] G. Joseph, et al., Evidence on the Use of Indoor Air Filtration as an Intervention for Wildfire Smoke Pollutant Exposure at 11 (2020) (gas-phase filters "need to be replaced frequently due to their limited lifespan"). See also U.S. EPA, Residential Air Cleaners - A Technical Summary at 7, 32-33 (3rd ed. 2018) ("studies of air cleaners in homes that address gas-phase pollutants are extremely limited, and consistent reductions have not been demonstrated.")

Portable Air Cleaners. Portable air cleaners can provide high-efficiency filtration in lieu of or in addition to in-duct filters. There is considerable evidence of the effectiveness of portable air cleaners that rely on fibrous filters to remove particles in the air, including during wildfire smoke events.[81]

Portable air cleaners are designed to filter the recirculating air in a single area or room using HEPA filters, which have a more than 99.9 percent removal efficiency for all particle sizes.[82] The Association of Home Appliance Manufactures (AHAM) has developed a widely-used standard, ANSI/AHAM AC-1, for measuring a portable air cleaner's efficacy using Clean Air Delivery Rate (CADR) as the metric.[83]

There are numerous educational materials on the use of portable air cleaners generally and during wildfire smoke events, especially in homes. In addition to the Wildfire Smoke Guide, EPA has produced detailed technical and consumer guidance documents on residential air cleaners, as well as a fact sheet on filtration for wildfire smoke.[84] Air cleaner guidance emphasizes that for the device to be effective, it must be appropriately sized for the space served and its filters must be replaced according to the manufacturer's instructions. Other factors affecting how well a portable air cleaner reduces indoor particle concentrations include fan speed and how frequently the unit is turned on.[85]

Costs involved in using portable air cleaners include the initial purchase price, as well as device maintenance (e.g., filter replacement) and operation (e.g., electricity costs).

DIY Air Cleaners. The COVID-19 pandemic produced a surge in the use of do-it-yourself (DIY) air cleaners, which are constructed by attaching one or more central air filters to a box fan. Many government agencies and non-governmental organizations now provide information or assistance to the public to help ensure the proper use of DIY air cleaners in situations where commercial air cleaners are unaffordable or otherwise unavailable.

The past few years have also seen an increase in research on the effectiveness and safety of DIY air cleaners. A 2021 study by researchers at Underwriters Laboratory, in cooperation with EPA, evaluated safety risks associated with fan overheating in several different scenarios and found that temperatures did not rise enough to cause burn hazards or fire ignition.[86] In terms of effectiveness, EPA has stated that "[e]vidence from multiple studies indicates that well-built DIY air cleaners can be of comparable

[81] See, e.g., B. Singer, et al., Reducing In-Home Exposure to Air Pollution (2016), U.S. EPA, Residential Air Cleaners - A Technical Summary at 7 (3rd ed. 2018); CDC, BRACE Technical Report Series: Evidence on the Use of Indoor Air Filtration as an Intervention for Wildfire Smoke Pollutant Exposure (2020) ("Based on the evidence, HEPA filter implementation can potentially reduce exposure to wildfire smoke pollutants and could mitigate negative health impacts.").
[82] U.S. EPA, What is a HEPA Filter?
[83] Assoc. of Home Appliance Manuf., Air Filtration Standards.
[84] See U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 22-24 (rev. 2021); U.S. EPA, Air Cleaners and Air Filters in the Home; U.S. EPA, Indoor Air Filtration. Many agencies and organizations produced guidance on using portable air cleaners during the pandemic. See, e.g., ASHRAE, In-Room Air Cleaner Guidance for Reducing COVID-19 in Air in Your Space/Room (2021); Harvard School of Public Health, Portable Air Cleaners: Selection and Application Considerations for COVID-19 Risk Reduction (2021).
[85] See, e.g., Wash. Dept. of Health, Improving Indoor Air Quality During Wildfire Smoke Events (June 2022); U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 22 (rev. 2021;); U.S. EPA, Wildfire Smoke Fact Sheet: Indoor Air Filtration.
[86] Underwriters Laboratory, Inc., An Evaluation of DIY Air Filtration (2021).

effectiveness to commercial air cleaners in reducing airborne particles."[87] The agency's evaluation of how well DIY filters reduced simulated wildfire smoke found that:

> DIY air cleaners were as effective as a small commercial air cleaner in reducing fine particle ($PM_{2.5}$) concentrations…DIY air cleaner performance could be improved by the addition of a no-cost cardboard shroud…Designs that incorporated multiple filters showed increased air cleaning capacity and were more cost-effective…DIY air cleaners with dirty filters loaded with smoke or dust were almost completely ineffective…[88]

The DIY devices included in the EPA study were louder and required more power to operate than commercial air cleaners, though EPA found that lower upfront costs and less expensive replacement filters made the DIY air cleaners more economical.[89] EPA provides tips on constructing and using DIY devices with single filters or multiple filters.[90] A recent study of nine DIY air cleaner prototypes concluded that prototypes containing multiple HEPA filters had higher clean air delivery rates compared to prototypes using a single filter, but that "single-filter designs had comparable values of CADR normalized by initial and annual operating costs."[91]

EPA has concluded that "DIY air cleaners are a cost-effective method for reducing smoke concentrations."[92] While "EPA does not recommend the routine use of DIY air cleaners as a permanent alternative to products of known performance (such as commercially available portable air cleaners)," the agency states that **"**this recommendation should not be interpreted to discourage the use of DIY air cleaners in circumstances when commercially available portable air cleaners or other products of known performance are not available."[93]

Other Air Cleaning Technologies. In addition to air cleaners that employ filters to remove particles mechanically, a variety of air cleaning technologies are commercially available. The ASHRAE Epidemic Task Force provided this general advice to building owners and managers in selecting an air cleaning device: "Only use air cleaners for which evidence of effectiveness and safety is clear."[94] EPA's technical summary on air cleaners states that air cleaning technologies such as photocatalytic oxidation and plasma systems have been shown to emit formaldehyde, carbon monoxide, and other pollutants as by-products, and that many electronic types of air cleaners can generate high amounts of ozone.[95]

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[87] U.S. EPA, Air Cleaners, HVAC Filters, and Coronavirus (COVID-19) (rev. Sept. 2023).
[88] U.S. EPA, Do-It-Yourself Air Cleaners: Making Cleaner Air More Accessible (2023). See also U.S. EPA, Research on DIY Air Cleaners to Reduce Wildfire Smoke Indoors.
[89] U.S. EPA, Do-It-Yourself Air Cleaners: Making Cleaner Air More Accessible (2023).
[90] See U.S. EPA, Air Cleaners, HVAC Filters, and Coronavirus (COVID-19) (rev. Sept. 2023); U.S. EPA, Research on DIY Air Cleaners to Reduce Wildfire Smoke Indoors.
[91] S. Sankhayan, et al., Optimization of a Do-It-Yourself Air Cleaner Design to Reduce Residential Air Pollution Exposure for a Community Experiencing Environmental Injustices. See also R. Dal Porto, et al., Characterizing the Performance of a Do-It-Yourself (DIY) Box Fan Air Filter, Aerosol Sci. and Tech. 56(6): 564-572 (2022)(showing effectiveness of a five-filter "Corsi-Rosenthal Box").
[92] U.S. EPA, Research on DIY Air Cleaners to Reduce Wildfire Smoke Indoors.
[93] U.S. EPA, Air Cleaners, HVAC Filters, and Coronavirus (COVID-19) (rev. Sept. 2023).
[94] ASHRAE Epidemic Task Force, Core Recommendations for Reducing Airborne Infectious Aerosol Exposure (2021).
[95] U.S. EPA, Residential Air Cleaners - A Technical Summary at 9 (3rd ed. 2018). See also Lancet COVID-19 Commission Task Force on Safe Work, Safe School, and Safe Travel, Designing Infectious Disease Resilience into School Buildings

In light of the recognized adverse health effects associated with ozone, some entities have established ozone emission standards for air cleaners. Two national UL standards for testing ozone emissions from air cleaners establish different criteria for compliance – UL 867 (50 ppb above ambient concentration) and UL 2998 (5 ppb above ambient concentration).[96] ASHRAE Standard 62.1 (§5.9.1) requires air cleaning devices that generate ozone to be listed and labeled in accordance with UL 2998. The state of California adopted ozone standards for air cleaning devices available for sale in California and requires such devices to be certified by the state as meeting the rule's 50 ppb standard. 17 Ca. Code Regs. §§94800–94810.[97]

Scope of the Report

This report provides information about state policies to reduce indoor exposure to wildfire smoke, with the goal of assisting jurisdictions in developing or strengthening their policies and programs. The report reflects ELI's review of these policies and is also informed by conversations with agency officials charged with implementing some of the policies described here. Actions to address wildfire smoke are complex and cut across many areas of authority. This report does not purport to capture all relevant state policies and programs, but the sections that follow provide many prominent examples.

State-Level Policies. The term policy as used here refers mainly to state laws and regulations, which can be important for providing the funding and formal direction needed to sustain program activities. Part Two also describes selected state programs independent of their legislative or regulatory authority. Policies and programs at the tribal, local, and federal levels are critical to reducing smoke exposures but are not the subject of this report.

Recent Policy Developments. The emphasis here is on wildfire smoke policies that have been established in the past few years. The highlighted policies are concentrated in, but not exclusive to, western states that have been most heavily impacted by wildfires.

Indoor Exposures. The report addresses the indoor environment because that is where most exposure to wildfire smoke occurs for people who do not work outside. Much of the discussion centers on promoting enhanced filtration of the air inside buildings, with some discussion of related measures such as indoor temperature control and air sealing.

The report does not discuss policies aimed at preventing structures from burning, nor does it address potential indoor exposures that may result from fire and smoke damage after a fire – e.g., smoke, ash, and soot that can "deposit particulate matter, volatile organic compounds…and other chemicals on furniture, walls, floors, and other surfaces."[98]

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through Improvements to Ventilation and Air Cleaning at 6 (2021) (noting that other "additive technologies," such as bipolar ionization, plasma systems, air cleaning units with ionizers or UV, dry hydrogen peroxide, and photocatalytic oxidation, "are generally considered less scientifically defensible due to their often unproven efficacies and due to their potential for degrading the quality of the air through the generation of harmful secondary pollutant").

[96] See UL Solutions, Zero Ozone Emissions Validation and Revised Standard for UL 867 - Electrostatic Air Cleaners.

[97] See Cal. Air Resources Board, Air Cleaner Information for Consumers.

[98] Col. Dept. of Public Health & Envt., Indoor Air Quality After a Fire. See also Cal. Dept. of Public Health, Wildfire Cleanup: Considerations for California's Public Health Officials (2019); Or. Dept. of Envtl. Quality, How to Safely Clean Up Ash and Debris from Burned Buildings.

Policies Covering Homes, Schools, and Workplaces. Many policies discussed in the report apply specifically to homes, schools, child care facilities, and workplaces, while some of the discussion is more general and could be applicable to other buildings as well. The report does not review laws and regulations that govern health care-related facilities or other specific types of regulated facilities.

Policies Focused on Smoke from Wildfires. While preventing and limiting wildfires in the first place is an important means of reducing the health impacts of wildfire smoke, this report focuses on preparing for and responding to the smoke that is produced by wildfires. The report uses the term "wildfire smoke" rather than "wildland fire smoke" and does not provide a detailed review or discussion of smoke management programs or other state policies governing prescribed burns. Nevertheless, many of the policy strategies discussed here are also important for reducing smoke from planned fires, and some prescribed burn policies are highlighted as well.

Maintaining Safe Indoor Temperatures

Although this report focuses primarily on air filtration, maintaining safe indoor temperatures is an important consideration for protecting against heat-related illness and for reducing wildfire smoke exposure. Staying indoors and closing windows during a wildfire smoke episode may not be feasible if a home lacks air conditioning or other means of maintaining safe indoor temperatures. As the EPA Wildfire Smoke Guide underscores: "An important caveat about advising people to stay inside and close windows and doors of homes without air conditioning is the increased risk of heat stress. Even without smoke exposure, extreme heat poses a substantial health risk, especially for at-risk groups, including young children, the elderly, those with chronic diseases or disabilities, and pregnant women. These at-risk groups largely overlap with those at higher risk from smoke exposures." U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 18 (rev. 2021).

Close to 90 percent of U.S. households used air conditioning in 2020, though use varies by region, income, and ownership status. The western U.S. has the lowest rate of air conditioning use (75 percent). While almost 92 percent of U.S. households with annual income over $60,000 used air conditioning in 2020, that number decreased to around 85 percent for households under $60,000. Air conditioning use is around 91 percent for those who own their homes, compared to 83.5 percent for renters. U.S. Energy Info. Admin., 2020 RECS Survey Data – Housing Tables (Air Conditioning).

Some air conditioners can help filter the air, but some also may allow smoke to enter a building. Thus, EPA recommends making sure that central air conditioning systems are set to recirculate and closing outdoor dampers on window air conditioning units. The agency advises against using portable air conditioners that have a single hose or evaporative coolers because in smoky conditions these devices "can result in more smoke being brought inside." U.S. EPA, Wildfires and Indoor Air Quality.

To counter the environmental and climate impacts of increased air conditioning, agencies can promote strategies for sustainable indoor temperature control in policies and programs governing building design, construction, and retrofit. In addition to more efficient building envelopes and HVAC systems, strategies for minimizing indoor heat gain include external shading, cool/green roofs, and innovative paving and building materials. See generally U.S. Dept. of Energy, Design for Extreme Heat; U.S. EPA, Heat Island Cooling Strategies; U.N Envt. Programme, Beating the Heat: A Sustainable Cooling Handbook for Cities (2021).

PART TWO

STATE POLICY STRATEGIES

Wildfire smoke is a serious and widespread public health problem that calls for sustained policy and program initiatives at all levels of government. States have a central role to play both in establishing direct measures for preventing and reducing smoke exposure in buildings and in supporting tribal and local actions.

It is important for state wildfire smoke policies and programs to identify and reach those who are at heightened risk of health impacts and least equipped to take the recommended steps for reducing exposure. The national Wildland Fire Mitigation and Management Commission emphasized the importance of addressing inequities in smoke exposure in its 2023 report:

> [F]actors such as socioeconomic status, housing, outdoor employment, access to health care, race and ethnicity, access and functional needs, and language barriers all influence a person's ability to protect themselves through actions such as the use of air filtration, respirators, modifications of structures, or spending more time indoors. Given the potential extent of smoke impacts to communities, investments are needed in a range of preparation and mitigation efforts at the federal, state, local, Tribal, and territorial levels. Programs should put particular focus on addressing inequities and improving the mitigation opportunities available to communities with populations and households disproportionately impacted by wildfires and smoke exposures. Offerings should be made available to both renters and homeowners and designed to address smoke from both wildfire and beneficial fire.[99]

Policies that establish broad state-wide or agency-wide environmental justice and health equity priorities can help ensure wildfire smoke resources reach communities that face disproportionate and heightened risks.[100] For example, the Oregon Health Authority (OHA) has set a "single overarching strategic goal…[to] eliminate health inequities in Oregon by 2030," and that goal informs implementation of all of OHA's programs, including those established by the state's comprehensive 2021 wildfire law and OHA's "health in all policies" work with other state agencies.[101] Washington's 2021 Healthy Environment for All (HEAL) Act (SB 5141) requires several state agencies to, among other things, develop community engagement

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[99] Wildland Fire Mitigation and Management Commission, On Fire: The Report of the Wildland Fire Mitigation and Management Commission at 100 (2023) (citations omitted). See also J. Sacks, et al., At the Intersection: Protecting Public Health from Smoke While Addressing the U.S. Wildfire Crisis, Am. J. Respir. Crit. Care Med., Vol. 208, No. 7 at 756 (10/1/23) ("Community demographics and socioeconomic characteristics …influence the ability or willingness of individuals to take necessary actions"); S. D'Evelyn, et al., Wildfire, Smoke Exposure, Human Health, and Environmental Justice Need to be Integrated into Forest Restoration and Management, Current Envtl. Health Report, Vol. 9, 366-385 ("outdoor workers and socially disadvantaged groups with limited adaptive capacity can be disproportionally exposed.")

[100] For a compilation of state environmental justice laws and policies, see Environmental Justice State by State, Environmental Justice State by State Law Library & Database.

[101] Or. Health Authority, Oregon Health Authority Equity Advancement Plan at 5; ELI Communication with Oregon Health Authority (June, Dec. 2023). See also State of Oregon, Advancing Wildfire Protection: Wildfire Programs Advisory Council Annual Report at 10 (Jan. 2023)(emphasizing the importance of prioritization "to target resources to areas with 1) socially and economically vulnerable communities, and 2) high and extreme wildfire risk").

plans and incorporate environmental justice principles into its budget development and expenditure processes. At the federal level, President Biden's Executive Order 14008 established the initiative known as Justice 40, which sets a goal that disadvantaged communities receive 40 percent of the "overall benefits" from certain federal investments in climate, energy, and other sectors.[102]

The past few years have seen a notable increase in state wildfire smoke policies and programs, including measures to reduce exposure for those facing heightened risks. The following sections discuss five key strategies that have been addressed in these policies and that should be considered as part of a comprehensive policy approach:

- Section 1: Interagency Coordination and Emergency Planning
- Section 2: Information, Outreach, and Education
- Section 3: Cleaner Air Centers
- Section 4: Material Assistance for Air Filtration and Related Measures
- Section 5: Regulatory Requirements for Air Filtration and Related Measures

The report includes examples of policies from across U.S., but most of the examples that are specific to wildfire smoke are from three western states that have enacted significant wildfire legislation in recent years – Oregon, California, and Washington. Oregon enacted a comprehensive wildfire law in 2021 (SB 762) that included new programs to distribute air cleaners, fund cleaner air centers, and support local smoke management planning, among other things. California has enacted multiple wildfire-related bills that require actions to reduce indoor smoke exposure, from cleaner air shelters and air monitoring to local emergency planning. Washington passed legislation in 2023 (HB 1578) to address wildland fire and smoke in areas of increasing population density, including requirements for information and outreach around smoke risks and impacts. These states also have adopted smoke management requirements for prescribed burns, as well as occupational safety and health rules on wildfire smoke.

Beyond legislation and regulations, state agencies have used general statutory authority to implement important programmatic measures to address wildfire smoke, such as the creation of an advisory group in Washington to provide technical support to local health officials, the development of guidance for public health officials in California, and numerous other outreach and education initiatives.

In addition to wildfire smoke policies and programs, the report describes measures that are not specific to wildfire smoke but nonetheless address smoke risks *indirectly*. Among the most notable are building codes requiring high-efficiency filtration, as recently adopted in California and Washington. Other examples include facility requirements for schools, child care buildings, and rental housing; healthy homes and related grant programs; funding to expand tribal and local environmental health capacity; and Medicaid initiatives to pay for air filters and other equipment to reduce indoor air health risks.

The sections that follow do not provide detailed information on how policies have been implemented but instead offer a starting point for understanding policy approaches taken to date. Although the policies described here are not necessarily perfect models, they illustrate measures that can be adapted to a state's legal and institutional framework to protect people from wildfire smoke indoors.

[102] The White House, Justice 40: A Whole-of-Government Initiative.

SECTION 1: INTERAGENCY COORDINATION AND EMERGENCY PLANNING POLICIES

Multiple state agencies and programs have expertise in air quality monitoring, public health, fire management, and other areas that are important for a comprehensive approach to reducing smoke exposure. Coordination and communication among different programs are thus essential for maximizing program resources and effectiveness. There are myriad opportunities for integrating cross-agency expertise into wildfire smoke policies and programs – e.g., ensuring that all agencies have current smoke forecast and air monitoring data to inform risk communication and including input from multiple agencies in the development of new rules governing workplace health and safety, smoke management, and other related issues.

This section describes state policies such as those in Washington and Oregon that establish high-level coordination and planning around wildfire smoke preparedness and response by establishing written state plans, convening coordination calls before and during wildfire season, and creating designated programs and staff positions. The section also notes some of the ways that state policies address support for local wildfire smoke planning by highlighting a California policy that requires the development of local air quality emergency plans, an Oregon policy that provides funding and guidance for local governments to create smoke response plans, and policies in Washington and Oregon that provide public health funding for local governments to address a range of environmental health issues such as wildfire smoke.

Agencies at all levels of government are involved in preventing and mitigating wildfire smoke exposure. State agencies work closely with federal partners, as well as with the tribal and local government agencies and organizations that play a critical role in preparing for and responding to wildfire smoke events in their communities.

Several areas of state authority may be directly engaged in addressing wildfire smoke risks.

Health. State, tribal, and local health agencies "play key roles preparing for, responding to, and recovering from health impacts caused by wildfire."[103] State health agencies develop educational resources, communicate information to the public, and advise and assist other agencies in addressing wildfire smoke. State health agencies may also manage technical and/or financial assistance programs for reducing indoor environmental exposures, and in some states, they implement IAQ-related standards for schools and other buildings. Public health data analysis conducted by state health agencies can be an important resource for understanding wildfire smoke health risks and impacts, tailoring risk communication, and informing policies and programs.

[103] Wildland Fire Mitigation and Management Commission, On Fire: The Report of the Wildland Fire Mitigation and Management Commission at 92 (Sep. 2023).

Environment. State environmental protection agencies implement regulations and programs governing air quality, including requirements for prescribed fires and other types of approved burning. They conduct air monitoring and smoke forecasting and disseminate that information. They may also provide financial assistance for local actions to reduce smoke exposures. In some states, such as Washington and California, regional air agencies have considerable responsibility for implementing state air quality laws and are also involved in wildfire smoke activities.

Forestry/Natural Resources. State natural resource and land management agencies prevent, prepare for, and respond to wildfires. They may also implement rules and programs governing prescribed burning.

Occupational Safety and Health. A majority of states enforce occupational safety and health standards for private and/or public workplaces. Those rules might address wildfire smoke specifically or include more general requirements for reducing indoor air exposures. State occupational health agencies also provide technical assistance and consultation to employers on reducing workplace risks.

Emergency Management. Emergency management agencies are involved in a variety of disaster planning and response activities, which might include shelters and cleaner air spaces for those affected by wildfire smoke episodes.

Other state agencies may play an indirect role in reducing wildfire smoke exposure – e.g., by funding building upgrades and equipment or by regulating indoor environmental conditions through building codes, housing codes, or facility licensing.

Federal agencies with a direct role in wildland fire and smoke management include the land management agencies at the Department of Interior (Bureau of Land Management, National Park Service, U.S. Fish and Wildlife Service, Bureau of Indian Affairs) and the Department of Agriculture (U.S. Forest Service). EPA regulates air quality, supports air quality monitoring, and provides extensive information about wildfire smoke and best practices for reducing exposure. Other agencies that address wildfire smoke include the National Oceanic and Atmospheric Administration, which provides wildfire forecasting and monitoring information, and the Centers for Disease Control and Prevention (CDC), which conducts research and provides information on public health impacts from fires. Federal agencies participate in a variety of interagency coordinating bodies to prepare for and respond to wildfire events. For example, the Forest Service coordinates the Interagency Wildland Fire Air Quality Response Program (IWFAQRP), a prominent program that provides technical assistance, air quality monitoring, and smoke modeling during wildfire smoke events.[104]

Given the many state programs relevant to addressing wildfire smoke, close coordination and communication among state agencies (and with non-state partners) are essential for marshalling expertise across disciplines, maximizing state resources, and reaching those in greatest need of assistance.

[104] IWFAQRP, Interagency Wildland Fire Air Quality Response Program. In addition, the National Interagency Fire Center (NIFC) supports on-the-ground wildland firefighting efforts, develops wildland fire policy, and "serves as the logistical, intelligence and decision-support center for wildland fire and other all-hazard emergency incidents throughout the nation." NIFC, What is NIFC?

Establishing Written State Plans Addressing Wildfire Smoke

Statewide plans are an important tool for establishing a coordinated approach to addressing hazards such as wildfire smoke. In addition to clarifying the roles of individual agencies, plans can discuss how programs will work together rather than in isolation. Plans can set forth specific agency actions to address indoor exposure to wildfire smoke, including explicit consideration of communities and individuals that are most vulnerable to the impacts of wildfire smoke exposure.

- *Washington's* wildfire smoke plan is included in the state's Comprehensive Emergency Management Plan as an appendix titled "Wildfire Response – Severe Smoke Episodes." The Appendix identifies each agency involved and its anticipated level of involvement during smoke episodes. It includes information about indoor air quality and notes: "Indoor air quality may be poor in older dwellings and buildings without adequate mechanical ventilation. These may include schools, community centers with care centers, nursing homes, or group homes. When air quality deteriorates, especially over periods of days or weeks, it becomes increasingly important [to] assess indoor air quality for these and other types of facilities..."[105]

- In *Oregon*, the Wildfire Response Protocol for Severe Smoke Episodes "is intended to provide guidance for the local, state, tribal, and federal agencies in Oregon who respond to severe smoke episodes caused by large or long-duration wildfires and to ensure a coordinated response to mitigate impacts on public health." The document highlights general responsibilities, outlines agency actions and assistance (e.g., identifying cleaner air spaces, providing smoke/health updates), and establishes annual and as-needed coordinating calls.[106]

- The *Idaho* Department of Environmental Quality implements the Wildfire Smoke Event Response Protocol, which outlines coordination among state, federal, and tribal agencies.[107]

Wildfire smoke preparedness and response measures could also be incorporated into other types of existing state plans. State Hazard Mitigation plans are one potential vehicle for establishing measures to reduce the risks and impacts of wildfires, and those measures could include reducing indoor wildfire smoke exposure in addition to making buildings and other structures more resistant to fire.[108] The *Nez Perce Tribe* is an example of a jurisdiction that has included in its Natural Hazard Mitigation Plan improved filtration and indoor air quality as a mitigation action for addressing wildfire smoke hazards. The plan designates IAQ and filtration as high priority items for reducing the possibility of damage and losses due to wildfire, including a "cache of air quality filtration systems that can be provided to residents of vulnerable populations or commercial buildings for shelter in place purposes."[109]

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[105] Wash. Military Dept., Washington State Comprehensive Emergency Management Plan, ESF 8 Attachment 1 to Appendix 5 – Severe Smoke Episodes at ESF8-5-8 (May 2022).
[106] State of Oregon, Wildfire Response Protocol for Severe Smoke Episodes at 1, 5-7 (Aug. 2023).
[107] Idaho Dept. of Envtl. Quality, Wildfire Smoke. The Arizona Department of Health Services has developed an All-Hazard Emergency Response Plan for the agency that includes a Wildfire Response appendix describing the agency's role in addressing health impacts of wildfires and laying out the role of supporting agencies at the state, federal, and local levels. Ariz. Dept. of Health Services, All-Hazard Emergency Response Plan (2023).
[108] See generally U.S. Federal Emergency Management Agency (FEMA), Hazard Mitigation Planning.
[109] Nez Perce Tribe, Natural Hazard Mitigation Plan 2019 Revision at 95.

Climate action plans could also establish goals and actions for addressing wildfire smoke exposure. Some state climate plans discuss the health impacts of wildfire smoke and the importance of forest management, as well as the need to ensure that plans address communities most vulnerable to climate impacts. In *Colorado*, the recently published Climate Change Preparedness Roadmap goes further, by including a specific smoke-related action item. A 2023 Colorado law (SB 22-206 §4) required the development of a roadmap that "maximizes the use of resiliency principles for the state's built environment," takes into account communities that are "particularly vulnerable to the impacts of climate change, and identifies opportunities for projects, policies, and strategies to protect the state's most vulnerable residents with the goal of attaining a more equitable future." The roadmap released in December 2023 recognizes that green building standards have "co-benefits for protecting against wildfire smoke or external pollution" and sets a goal of "increase[ing] adaptation/resilience standards with the [state's] High Performance Certification Program," which requires state-funded projects to meet third party green building standards. The Roadmap commits the state to "evaluat[ing] options to strengthen climate adaptation considerations within this program."[110]

Convening State Wildfire Smoke Coordination Calls

In many states, interagency calls provide an ongoing structure for coordinating wildfire preparedness and response activities. Coordinating calls are generally open to and involve a wide range of state, federal and local agencies, as well as non-governmental parties. Calls are held when there is a smoke incident and may also be convened outside of wildfire season to help prepare for fires and to make any necessary updates to state planning documents. Calls during wildfire events may provide a forum for discussing the issuance of air quality alerts and dissemination of public health messaging, among other things.

- In *Washington*, the state's emergency plan expressly directs agencies to hold "routine conference calls…[that] include updates on the status of major ongoing wildfires and an opportunity to discuss current conditions related to air quality, local health impacts, smoke forecasts, recommended public actions, communications, emergency actions such as evacuation, and other issues important to the group." The calls, which are led by the health and environmental agencies, support coordination of wildfire smoke response efforts across local and state agencies when significant smoke impacts are anticipated or are occurring.[111]

  In addition, the Washington Department of Health has established and regularly convenes the Wildfire Smoke Advisory Group, an innovative collaboration that focuses on improving technical guidance and resources for local partners (see Section 2).

- In *Oregon*, the health and environmental agencies convene statewide interagency wildfire smoke coordinating calls that are also attended by tribal and local governments and other stakeholders. During wildfire emergencies, the calls are held often to coordinate response activities and make decisions on issuing air quality alerts. During the off-season, agencies host a post-season recap

[110] State of Colorado, Colorado Climate Preparedness Roadmap at 59 (Dec. 2023). See also Co. Rev. Stat. §24-38.8-103.
[111] Wash. Military Dept., Washington State Comprehensive Emergency Management Plan, ESF 8 Attachment 1 to Appendix 5 – Severe Smoke Episodes (May 2022); ELI Communication with Wash. Dept. of Health (June 2023).

meeting for all stakeholders, which includes reviewing results from a post-season survey, as well as a meeting for the key agencies to review processes and discuss updates to the state's Wildfire Response Protocol. An interagency summer hazards call addressing the interplay among multiple hazards, including wildfire smoke and heat, is convened annually for health response partners such as local health agencies, tribes, and state-funded community based organizations.[112] The Oregon Health Authority has also established regular wildfire smoke meetings within the agency during wildfire season (late spring through fall) to coordinate and share information among several offices and teams that play a role in addressing smoke impacts.[113]

Designating Wildfire Smoke Programs and Staff

Just as it is important to have funded staff positions for conducting air quality monitoring, responding to wildfires, and implementing prescribed burns, it is important to have capacity in public health and other agencies to coordinate wildfire smoke outreach and response. Washington and Oregon are examples of states that have recently established staff positions for coordinating such actions within and between agencies.

- In *Washington*, the Department of Health has a staff position dedicated to wildfire smoke within the Office of Environmental Public Health Sciences (Climate and Health Section). The position is responsible for leading the agency's internal and external coordination and also coordinates the agency's Wildfire Smoke Advisory Group.[114] In addition, the Washington Department of Natural Resources (DNR) received funding from the state's 2023 wildfire law (HB 1578) to create new positions that will allow for more planning and coordinating with the Department of Health and other agencies to expand community engagement, particularly in heavily impacted areas of the state.[115] The wildfire law requires DNR to "coordinate cross-agency" in conducting monitoring and in providing information on wildland fire smoke risks and impacts to other agencies and the public.

- In *Oregon*, the state's 2021 wildfire legislation (SB 762) established new positions within state agencies to carry out programs created by the law. For example, the Oregon Health Authority created a permanent position focused on wildfire smoke and public health, situated in the agency's Health Security Preparedness and Response Program. This position coordinates with other programs within and outside OHA and has been responsible for implementing the air filter distribution program established by SB 762 (see discussion in Section 4).[116] The legislation also created a Wildfire Programs Director position within the Governor's office for overseeing implementation of the new law and for "[c]ordinating and integrating activities of state agencies and other entities that are required or authorized by [the law] in order to optimize the efficiency and effectiveness of the

[112] ELI Communication with Or. DEQ (Dec. 2023) and Or. Health Authority (June 2023). State of Oregon, Wildfire Response Protocol for Severe Smoke Episodes at 11-12 (Aug. 2023).
[113] ELI Communication with Or. Health Authority (June 2023). Programs involved include epidemiology, climate health, medical assistance, community engagement and the public information officer.
[114] ELI Communication with Wash. Dept. of Health (May 2023, Dec. 2023).
[115] As of December 2023, this and other new positions funded under the legislation had not yet been filled pending fiscal allocations. ELI Communication with Wash. DNR (Dec. 2023).
[116] ELI Communication with Or. Health Authority (June 2023).

activities." A Wildfire Programs Advisory Council was set up to advise the director and to prepare an annual report for the legislature describing progress in implementing the law.[117]

Developing Local Wildfire Smoke Plans and Programs

Local agencies play a central role in addressing wildfire smoke. California, Oregon, and Washington have enacted policies in recent years that illustrate some of the approaches states can take to promoting local wildfire smoke planning and response – e.g., requiring local plans, providing technical or financial support for the development of local plans, and providing funding to increase local public health capacity to address wildfire smoke and environmental health more broadly.

Requiring Local Government Plans

States that require local emergency plans or comprehensive plans could require jurisdictions to incorporate into the plans measures to prepare for and respond to wildfire smoke and other air quality emergencies.

In recent years, *California* has enacted two laws that require local jurisdictions to adopt wildfire-related plans.

- In 2021, California enacted local emergency planning legislation that requires each county to develop a plan for use in the case of a "significant air quality event caused by wildfires or other sources," defined as "the period of time in which the duration of exposure and the level of particulate matter, or other indicators of air quality, are likely to result in negative health impacts." Cal. AB 619 §3; Cal. Health & Safety Code §107250(f).

  The law requires the California Department of Public Health (CDPH) to develop a model plan and requires county-specific air quality plans to address all recommendations and guidelines in the state plan. According to agency officials, CDPH is currently developing a plan in consultation with stakeholders for counties to use in creating their local plans. The state plan will include guidelines and recommendations that address adverse health effects, outreach and awareness, and the delivery of emergency provisions, with a focus on those at greatest risk.[118]

  Counties must incorporate the new air quality plan into their broader emergency plans prior to the next revision of the emergency plan.[119] AB 619 is notable for requiring local plans to include a designated lead for implementing the plan and to address key steps for reducing indoor exposures: public respite facilities during poor air quality and other weather-related events; public outreach during a disaster, including health threats and response actions; and emergency provision of respiratory protection, air cleaners, medications, and oxygen for people with respiratory and pulmonary diseases. Cal. AB 619 §1; Cal. Govt. Code §8593.25(a)(2).

[117] See Or. Office of the Governor, Wildfire Programs Advisory Council.
[118] ELI Communication with Cal. Dept. of Public Health (Dec. 2023).
[119] California's State Emergency Plan applies to political subdivisions of the state and "the governing body of each political subdivision shall take such action as may be necessary to carry out the provisions thereof." Cal. Gov. Code §8568.

- In 2019, the California legislature adopted a law (AB 661) directing one jurisdiction impacted by wildfire smoke, the Sacramento Metropolitan Air Quality Management District, to develop a Wildfire Smoke Air Pollution Emergency Plan "as an informational source for local agencies and the public during a wildfire smoke air pollution emergency." The legislation required the plan to set forth a "clear designation of responsible agencies and their respective roles and actions" and to discuss "health protective recommendations and guidelines at different tiers of air quality" and "strategies for vulnerable populations." The plan, published in 2022, addresses coordination among agencies and organizations and includes a considerable amount of information about best practices and considerations for reducing indoor exposure by, e.g., improving HVAC filtration, using air cleaners, weatherizing buildings, and establishing cleaner air centers.[120]

States could also create requirements or incentives for local jurisdictions to incorporate wildfire smoke measures into other local plans, such as community wildfire protection plans.[121] *Multnomah County, Oregon*, is an example of a jurisdiction that has addressed wildfire smoke exposure extensively in its community wildfire protection plan. The wildfire smoke section of the plan was developed by a subcommittee comprising a broad range of interests and assisted by a survey of county residents. The plan presents a smoke risk assessment for the county and includes a table of 25 specific actions that represent "a roadmap for reducing wildfire smoke risk over time." The listed actions address coordination, outreach, cleaner air centers, and distribution of air filters, and many expressly incorporate working with populations most sensitive to wildfire smoke.[122]

States could also consider establishing wildfire emergency planning requirements for *specific types* of facilities such as schools, child care facilities, and workplaces. States could provide templates for stand-alone plans or for wildfire-specific information to be incorporated into existing emergency plans maintained by the facility.[123] States could also provide content for emergency and disaster preparedness training for employees at schools, child care facilities, and workplaces. *Washington's* workplace rules for wildfire smoke, which apply mainly to outdoor workplaces, require covered employers to develop a wildfire smoke response plan. In *Montana***,** state rules require schools to have a "protocol in place on how to limit the infiltration of outside air into the school during poor air quality conditions," and the state health department has developed a model protocol. Mt. Admin. Code §37.111.827. (See Section 5 for a description of the Washington and Montana rules.)

[120] See Sacramento County Public Health, et al., Wildfire Smoke Air Pollution Emergency Plan for Sacramento (2022).
[121] See generally FEMA, Creating a Community Wildfire Protection Plan (2020); Fire Adapted Communities, Community Wildfire Protection Plan Portal and Data Library.
[122] Multnomah County, Oregon, Multnomah County Community Wildfire Protection Plan chap. 6, pp. 178-189 (2023).
[123] Most child care facilities, for example, are required to have an emergency plan. In order for child care providers to receive federal child care payments, state child care licensing rules must require them to undertake emergency preparedness and response planning, including "procedures for evacuation, relocation, shelter-in-place and lock down, staff and volunteer…training and practice drills, communication and reunification with families, continuity of operations, and accommodation of infants and toddlers, children with disabilities, and children with chronic medical conditions…"45 C.F.R. §98.41(a)(1)(viii).

Supporting the Development of Local Plans

New policies in *Oregon* establish measures to support local jurisdictions in developing plans for addressing smoke impacts.

The Oregon Department of Forestry (ODF) recently revised its smoke management rules for prescribed burns. Previously, the rules did not allow ground level smoke to enter areas designated as "smoke sensitive receptor areas" or "SSRAs" – areas that receive the highest level of protection under the state's smoke management plan, typically densely populated locations with a past history of smoke incidents or other air quality issues.[124] The new rules establish a one-hour average smoke intrusion threshold for SSRAs (70 $\mu g/m^3$ for $PM_{2.5}$). The rules also allow SSRAs to receive an exemption from the one-hour intrusion standard (such that smoke impacts surpassing the one-hour threshold – but not the 24-hour average threshold – are deemed smoke incidents rather than smoke intrusions) if the SSRA develops and implements a "community response plan" (CRP) for addressing smoke. Or. Admin. Code §629-048-0180(3); 629-048-0005(27).[125]

Although the Oregon rules do not require all localities throughout the state to develop a community response plan, the rules "recommend [that] communities that are SSRAs and have experienced repeated smoke incidents and/or intrusions in the past collaboratively develop a community response plan and program," and the availability of an exemption from the one-hour $PM_{2.5}$ standard offers an incentive for doing so. Or. Admin. Code §629-048-0180(2). CRPs are primarily intended to address prescribed burns but can also be developed and implemented for wildfires. A central goal of a CRP is to "promote communication between the entities that conduct prescribed fire, the local public health authority, vulnerable populations, and the public," with a focus on addressing smoke impacts on people who are most vulnerable to smoke exposure.[126]

The Oregon smoke management rules set forth the minimum elements of a CRP in order for a SSRA to receive an exemption from the regulatory one-hour $PM_{2.5}$ standard, though local public health agencies take the lead in developing community response plans that reflect community needs and capacity. The Oregon Health Authority, the Department of Environmental Quality (DEQ), and the Oregon Department of Forestry work together to review the plans and assist communities.[127]

In order to receive an exemption, a community's CRP must include a public communication and education strategy as outlined in the communication framework established by DEQ. The CRP must include the following specific measures for reaching populations that are vulnerable to smoke exposure: (1) A description of populations in an SSRA community that are vulnerable to the health effects of short-term smoke; (2) Adequate means by which the public, especially vulnerable populations in the SSRA community, will be notified in a clear and reliable way of anticipated smoke impacts in a timely manner; (3) Adequate options for protecting the health of vulnerable populations (or helping such populations to protect themselves) from short-term exposure to smoke; and (4) A plan and program for

[124] Or. DEQ, Smoke Management for Prescribed Burning on Forestlands.
[125] See also Or. Dept. of Forestry, Operational Guidance for the Oregon Smoke Management Program (2023).
[126] Or. DEQ, Smoke Management for Prescribed Burning on Forestlands.
[127] ELI Communication with Or. Health Authority (May 2023).

communications between the entities that conduct prescribed fire, the local public health authority, the public, and populations vulnerable to smoke. Or. Admin. Code §629-048-0180(2).

The rule states that CRPs "should be coordinated through the local public health authority, but developed collaboratively with members or representatives of vulnerable populations," other agencies, and interested members of the public. SSRAs that have received an exemption must demonstrate they are implementing their CRP through an annual report prepared by the local health authority. Or. Admin. Code §§629-048-0180(2)(b), (3)(f).

In 2021, the state's comprehensive wildfire legislation provided funding for DEQ to support local communities in developing and implementing community response plans. Or. SB 762; Or. Rev. Stat §468A.830. The agency provided $180,000 to four communities to develop CRPs and $375,000 to five communities to support CRP staffing and implementation.[128] In its summary of the funding program, DEQ noted that many other local communities want to develop plans but need financial and technical support to do so, and that CRPs still have not been established in over 80 percent of the state's SSRAs.[129]

Public Health Funding to Build Capacity for Tribal and Local Wildfire Smoke Preparedness

Tribal and local public health programs are vital to protecting public health, yet resources and capacity vary widely among jurisdictions within a state. As the national Wildland Fire Mitigation and Management Commission underscored in its 2023 report, "[t]ribal, state, and local public health agencies need increased support to promote community readiness and risk reduction in the context of fire."[130]

Sustainable and equitable state funding for tribal and local health agencies and organizations can facilitate planning that addresses holistically a variety of environmental health risks facing community residents, including wildfire smoke exposure. Oregon and Washington are two states that have increased their general public health funding to tribal and local agencies and organizations in recent years.

- In *Oregon,* a 2015 law (HB 3100) adopted foundational capabilities and programs for state and local public health authorities. Since then, the legislature has provided biennial funding to the Oregon Health Authority to implement a Public Health Modernization strategy that aims to create an "equity-centered public health system."[131] Two of the four goals of the strategy address environmental health directly and potentially encompass wildfire smoke issues: "strengthen and expand communicable disease and environmental health emergency preparedness" and "protect communities from environmental health threats through public health interventions that support equitable climate adaptation."[132] The budget of $60 million for Public Health Modernization in the 2021-2023 biennium included funding for tribes, local public health agencies, community-based

[128] Or. DEQ, Senate Bill 762: DEQ Community Smoke Response and Preparedness Funding Report at 4 (2023). See also Or. DEQ, Smoke Management - Community Response Plan Development Projects Request for Proposals (2021). For links to individual CRPs, which vary in their level of detail, see Or. Prescribed Fire Council, Smoke Management.
[129] Or. DEQ, Senate Bill 762: DEQ Community Smoke Response and Preparedness Funding Report at 17 (2023).
[130] Wildland Fire Mitigation and Management Commission, On Fire: The Report of the Wildland Fire Mitigation and Management Commission at 92 (Sep. 2023).
[131] See Or. Health Authority, Public Health Modernization.
[132] Or. Health Authority, Oregon Public Health Modernization Evaluation Report 2021-2023 at 6 (2023).

organizations, and the state health department.[133] Much of the biennial funding has been used to address environmental health, with a significant focus on wildfire smoke.[134]

- As part of an effort to modernize the *Washington* public health system that began in 2012, the state enacted legislation in 2019 that codified restructuring and bolstering of public health funding to support "foundational public health services" (FPHS). FPHS are a set of defined core public health services that can be provided only or primarily by the governmental public health system (state, tribal, and local health agencies) and which must be present in every community in Washington to protect all people. Two FPHS areas, as determined in state law, are directly relevant to wildfire smoke – environmental public health and public health emergency planning. Wash. SSHB 1497; Rev. Code Wash. §§43.70.512, .515. The first significant budget contribution toward full FPHS funding was made by the state legislature in 2021. According to state officials, FPHS funding in recent years has led to an increase in system and local health agency capacity for addressing environmental health issues. In some jurisdictions, FPHS has strengthened the capacity to address wildfire smoke specifically. The state Department of Health has used FPHS to partially support the new staff position dedicated to wildfire smoke noted earlier.[135]

[133] Id. at 19.
[134] Id. at 16; ELI Communication with Or. Health Authority (March 2023).
[135] ELI Communication with Wash. Dept. of Health (June 2023, Dec. 2023).

Section 2: Information, Education, and Outreach Policies

Outreach and education are among the core functions of agencies that address wildfire smoke. State environmental agencies typically take the lead in collecting and disseminating data on air quality and smoke conditions. State health agencies develop and disseminate evidence-based information, messages, and guidance on wildfire smoke health effects and strategies for reducing indoor exposure. Tribal and local agencies and organizations are essential partners for state agencies in identifying the information that communities need and the best ways to communicate and disseminate that information.

This section highlights recent state policies and programs that address some of the important elements of state outreach and education initiatives, such as prioritizing outreach to underserved communities and people at heightened risk from exposure, providing air quality monitoring data, and developing technical guidance. It is also important to provide timely information to communities potentially affected by prescribed fire, and the section closes with examples of state policies that require notification and outreach in connection with prescribed burns.

Among the policies and programs highlighted here, Washington is notable for having established an advisory group dedicated to providing technical guidance to support wildfire smoke response efforts of local health staff. In recent years, Washington and other states have developed guidance materials on a range of key topics, including health risks, air filtration, and air monitoring.

Prioritizing Outreach to Underserved Communities and People at Heightened Risk from Wildfire Smoke Exposure

As a recent EPA report emphasized, "[i]nformation dissemination, specifically focusing on the potential risks of wildfire smoke exposure and actions a population can take is the initial step that can ultimately dictate whether individuals take actions to reduce exposure."[136] Thus, it is vital that information reach all people potentially affected by wildfire smoke, including those who are most vulnerable to health risks and those who may be underserved by government programs. In consultation with community partners,

[136] U.S. EPA, Comparative Assessment of the Impacts of Prescribed Fire Versus Wildfire (CAIF): A Case Study in the Western U.S. at 6-22 (2021).
It is beyond the scope of the report to review the social science and other research illuminating effective communication strategies generally or for wildfire smoke specifically. The National Institute for Environmental Health Sciences (NIEHS) recently noted that there are "currently limited studies on smoke risk communication." NIEHS, Partnerships for Environmental Health PEPH Newsletter, vol. 14, Issue 7 (July 2023). EPA recently funded a number of studies in this area. See U.S. EPA, Interventions and Communication Strategies to Reduce Health Risks of Wildland Fire Smoke Exposures. See also U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials (rev. 2021) (including information for public health agencies on communicating health risks and technical best practices through public advisories and other channels).

state agencies could advance this goal by developing materials with culturally-appropriate language and messages, translating materials into languages spoken by affected communities, ensuring that materials are accessible by disabled persons, and identifying effective communication channels.[137] Technical information on reducing wildfire smoke exposure could include measures that are feasible for people with limited incomes who may not have air conditioning or air cleaners, such as strategies for opening windows to air out a home, instructions for building and maintaining a DIY air cleaner, and ways to access cleaner air and cooling centers.[138]

Recently enacted state wildfire laws include provisions expressly addressing outreach to underserved communities and people at heightened risk.

- *Washington*'s 2023 wildfire law directs the Department of Natural Resources, in collaboration with the state health and environmental agencies, to "conduct community engagement and outreach related to wildfire smoke risks and impacts, particularly in regions of the state that experience disproportionately high levels of air contaminants and pollutants. Particular emphasis in outreach will be focused on overburdened populations, and vulnerable people, including outdoor workers, those older in age, those experiencing persistent health challenges, and those experiencing unstable housing arrangements…" Wash. HB 1578 §2.

- *California's* 2021 law directing the state to develop guidance for local air quality emergency plans requires that the guidance include: "best practices and recommended protocols for reaching out to inform the general public about the recommendations and guidelines and shall include best practices and recommended protocols for reaching out specifically to vulnerable populations, such as the homeless, elderly, disabled, and homebound." Cal. AB 619 §3; Cal. Health & Safety Code §107250.

  Separate California legislation enacted in 2019 requires counties to integrate "cultural competence" into their emergency plans, defined as "the ability to understand, value, communicate with, and effectively interact with people across cultures in order to ensure that the needs of all community members are addressed, with priority given to 'culturally diverse communities.'" Cal. SB 160 §2; Cal. Govt. Code §8593.3.5.[139]

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[137] See generally S. D'Evelyn, et al., Wildfire, Smoke Exposure, Human Health, and Environmental Justice Need to be Integrated into Forest Restoration and Management, Current Envtl. Health Report, Vol. 9, 366-385, 375 (2022); U.S. EPA, Comparative Assessment of the Impacts of Prescribed Fire Versus Wildfire (CAIF): A Case Study in the Western U.S. (2021); S. Hoshiko, et al., Responses to Wildfire and Prescribed Fire Smoke: A Survey of a Medically Vulnerable Adult Population in the Wildland-Urban Interface, Mariposa County, California, Int. J. Environ. Res. Public Health, 20:2, 1210 (2023). See also The White House, National Climate Resilience Framework (2023); A. Modaresi Rad, et al., Social Vulnerability of the People Exposed to Wildfires in U.S. West Coast States, Science Advances, 38:9 (2023).

[138] See generally, R. Treves, et al., Wildfire Smoke Clean Air Centers: Identifying Barriers and Opportunities for Improvement from California Practitioner and Community Perspectives, Soc. & Natural Res., 36:9, 1078-1098, 1084 (2022) (discussing outreach on cleaner air shelters); S. D'Evelyn, et al., Wildfire, Smoke Exposure, Human Health, and Environmental Justice Need to be Integrated into Forest Restoration and Management, Current Envtl. Health Report, Vol. 9, 366-385, 375 (2022) ("One pathway to equity can be achieved through community-tailored, culturally informed smoke management practices, achieved through early and continuous consultation with impacted communities.").

[139] Culturally diverse communities are defined as including "race and ethnicity…gender…age…sexual and gender minorities; people with disabilities; occupation and income level…education level; people with no or limited English language proficiency; as well as geographic location." Cal. SB 160 §2; Cal. Govt. Code §8593.3.5.

- Similarly, in *Colorado*, a 2023 law directly addresses the use of inclusive language in connection with emergency alerts for wildfires and other emergencies. The law requires and funds a study to be undertaken by the University of Colorado to determine "best practices for engaging local community organizations with connections to populations that speak a minority language" and identify resources available for providing grants to translate emergency alerts into those languages. Co. HB 23-1237 §2; Co. Rev. Stat. §23-20-145.

- *Oregon's* 2021 wildfire law, which directs the Department of Environmental Quality to monitor and communicate air quality conditions related to wildfire smoke, requires the agency to "[c]onduct community outreach in areas of this state that are prone to poor air quality attributable to elevated levels of particulate matter…" Or. SB 762, §13b.[140] In its 2022 annual report summarizing the law's implementation, the state Wildfire Programs Advisory Council emphasized the importance of reaching communities at extreme or high risk through partnerships with regional and local community organizations and stated that "[m]ultiple modes of engagement to reach populations in multiple languages across different levels of internet access, communication preferences, and education levels would also be needed."[141]

Providing Air Quality Monitoring Data

Air quality monitoring is a vital tool for understanding potential and current wildfire smoke risks. An important element of state outreach and education is communicating monitoring data to the public through web pages and other means, so that agencies and individuals can take appropriate steps to reduce exposure.

State agencies collaborate with federal, local, and tribal agencies to maintain a permanent network of air quality monitoring stations and to place temporary monitors during wildfire smoke events. Low-cost air pollution monitors are also being used by government agencies, building managers, and individuals to help fill gaps in the air quality monitoring network, and those devices comprise a growing share of air monitoring capacity across the country. As a 2020 article on wildland fire and air quality observed, "in large portions of the continental U.S., the only nearby measurements are from low-cost sensors."[142] Much of the data produced by low-cost air sensors (also referred to as low-cost air monitors) is available to the public and is used by state agencies.[143]

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[140] According to agency officials, outreach under SB 762 was conducted primarily by working with communities to develop CRPs and by providing funding to tribes. ELI Communication with Or. DEQ (Dec. 2023). See generally Or. DEQ, Senate Bill 762: DEQ Community Smoke Response and Preparedness Funding Report (Aug. 2023).

[141] State of Oregon, Advancing Wildfire Protection: Wildfire Programs Advisory Council Annual Report at 35 (Jan. 2023).

[142] D. Jaffe, et al., Wildfire and Prescribed Burning Impacts on Air Quality in the United States, J. Air Waste Mgmt. Assoc., 70:6, 583-615 (2020) (noting that as of 2019, PurpleAir had "over 4,000 units deployed within the continental U.S").

[143] See, e.g., Wash. Military Dept., Washington State Comprehensive Emergency Management Plan, ESF 8 Attachment 1 to Appendix 5 – Severe Smoke Episodes at ESF8-5-10 (May 2022) ("The Smoke Blog includes publicly reporting $PM_{2.5}$ low-cost sensors for outdoor measurements that have an applied smoke correction factor and appropriate averaging time (NowCast)"); South Coast AQMD, Information and FAQs about AQI (during wildfires, the agency calculates AQI by "blending" measurements from the high-quality regulatory monitors with "quality-controlled and calibrated low-cost sensors" as well as data generated by an air quality model).

Although there are a variety of air monitoring programs and initiatives, "[i]n many areas affected by wildfire smoke, air monitoring data may be limited or absent."[144] This section of the report describes federal air quality monitoring requirements and programs and provides examples of recent state policies aimed at expanding air monitoring in communities at risk from smoke and other air pollutants.

Federal Air Monitoring Requirements and Programs

Under the Clean Air Act, EPA sets primary (public health) and secondary (public welfare) National Ambient Air Quality Standards (NAAQS) for certain pollutants, including particulate matter. 42 U.S.C. §7409. The primary standards must be set at levels which, "allowing an adequate margin of safety, are requisite to protect the public health." 42 U.S.C. §7409(b). The current 24-hour standard for $PM_{2.5}$ is 35μg/m^3, and the annual mean standard is 12μg/m^3.[145] In January 2023, EPA proposed a rule to strengthen the annual NAAQS for $PM_{2.5}$.[146]

States with areas that do not meet federal air quality standards (nonattainment areas) must develop and obtain EPA approval of enhanced air pollution control measures to achieve and maintain compliance. These measures – laws, rules, and non-regulatory actions – are included in a State Implementation Plan (SIP) that is submitted to EPA for approval. 40 C.F.R. Pt. 51.

The Clean Air Act requires every state to maintain a network of permanent air monitoring stations to measure $PM_{2.5}$ and other criteria pollutants, and the data produced are used to determine compliance with federal NAAQS.[147] However, the current network of permanent air monitors is not necessarily designed to measure air quality during wildfire smoke events. During such events, local influences and conditions such as topography can create highly variable air quality conditions that are not always well-measured by the regulatory network. The U.S. Wildland Fire Mitigation and Management Commission recently concluded that "smaller population centers affected by smoke can lack adequate observational air quality data."[148]

Federal programs that augment monitoring capacity during smoke events include the Interagency Wildland Fire Air Quality Response Program (IWFAQRP), which maintains a cache of portable PM monitoring kits that are available upon request during wildfires and prescribed burns.[149] The program also provides Air Resource Advisors, technical specialists who can be dispatched to an incident to deploy temporary air monitors and to assist in predicting wildfire smoke dispersion, providing smoke forecasts,

[144] U.S. EPA, Wildfire Smoke Air Monitoring Response Technology (WSMART) Pilot.
[145] See U.S. EPA, NAAQS Table. The 24- hour standard for PM_{10} is 150 μg/m^3.
[146] See U.S. EPA, Proposed Revisions to the NAAQS for Particulate Matter (Jan. 2023) (proposing revising the annual $PM_{2.5}$ standard from 12 μg/m^3 to a value in the range of 9 – 10 μg/m^3 and soliciting comment on revising the level as low as 8.0 μg/m^3 and up to 11.0 μg/m^3).
[147] See U.S. EPA, Air Pollution Monitoring.
[148] Wildland Fire Mitigation and Management Comm., On Fire: The Report of the Wildland Fire Mitigation and Management Commission at 101 (2023). See also K. Kromar, et al., Adverse Health Impacts of Outdoor Air Pollution, including from Wildland Fires, in the United States: "Health of the Air," 2018-2020, Annals of the Amer. Thoracic Soc. at 9 (2023); D. Jaffe, et al., Wildfire and Prescribed Burning Impacts on Air Quality in the United States, J. Air Waste Mgmt. Assoc., 70:6, 583-615 (2020) (finding that data from temporary air monitors "suggests that current permanent monitors lack the spatial distribution to fully represent the overall human exposure to wildfire smoke, especially in rural areas").
[149] Interagency Wildland Fire Air Quality Response Program (IWFAQRP), Smoke Monitoring; IWFAQRP 2021 IWFAQRP Annual Report: A Nation in Wildfire Smoke (2021).

and communicating smoke impacts.[150] Some EPA regional offices loan air sensor equipment that can be used outdoors or indoors.[151] EPA's Wildfire Smoke Air Monitoring Response Technology (WSMART) pilot program loans air monitoring equipment and provides technical support to state, local, and tribal air organizations "to support supplemental air monitoring in areas affected by wildfire smoke and with observational data coverage gaps."[152] EPA also has provided grants to improve air monitoring more broadly, especially in underserved communities, and some of the projects funded thus far address air monitoring during wildfire smoke episodes.[153] In January 2024, EPA announced nine projects selected for funding under its Wildfire Smoke Preparedness in Community Buildings grant program, which includes indoor and outdoor monitoring as eligible activities.[154]

EPA runs the AirNow website (airnow.gov) to communicate air quality monitoring information via the familiar color-coded air quality levels.[155] In 2020, EPA and U.S. Forest Service launched the AirNow Fire and Smoke Map, which provides in one place information on fire locations, smoke plumes, and air quality. The AirNow Fire and Smoke Map integrates data from AirNow's permanent regulatory monitors, temporary $PM_{2.5}$ monitors deployed near fires, and thousands of low-cost PurpleAir sensors.[156] The low-cost sensor data was integrated in 2020 with the goal of "provid[ing] people with additional information on air quality during wildfires, especially in areas where AirNow monitors may not exist."[157]

These federal programs help fill the gap in monitoring capacity for wildfires, but as the Wildland Fire Mitigation and Management Commission acknowledged, "additional investments are needed."[158]

Recent State Policies Addressing Air Monitoring for Wildfire Smoke

State policy is important for ensuring adequate monitoring capacity in communities impacted by smoke. Where the existing network of permanent regulatory monitors does not reach areas impacted by wildfire smoke, state policies could provide for additional permanent monitors or for increasing the availability of temporary/portable monitors during a wildfire smoke event. State policies could also support the use of low-cost air sensors to fill in gaps in air monitoring networks in communities affected by wildfire smoke.

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[150] IWFAQRP, Air Resource Advisors. The IWFAQRP has also sent air resource advisors to some recent prescribed fires. J. Sacks, et al., At the Intersection: Protecting Public Health from Smoke While Addressing the U.S. Wildfire Crisis, Am. J. Respir. Crit. Care Med., 208:7 at 756 (2023). See also U.S. GAO, Wildfire Smoke: Opportunities to Strengthen Federal Efforts to Manage Growing Risks at 24 (2023) (citing Forest Service estimates that IWFAQRP maintains a cache of over 100 portable air quality monitors and sensors).

[151] U.S. EPA, Air Sensor Loan Programs.

[152] U.S. EPA, Wildfire Smoke Air Monitoring Response Technology (WSMART) Pilot. The devices provided by the program include two types of low-cost air sensors – the PurpleAir $PM_{2.5}$ sensor and Thingy AQ multi-pollutant sensor system.

[153] U.S. EPA, ARP Enhanced Air Quality Monitoring for Communities - Competitive Grant; U.S. EPA, Selections for the ARP Enhanced Air Quality Monitoring Competitive Grant.

[154] See U.S. EPA, Wildfire Smoke Preparedness in Community Buildings Grant Program.

[155] See U.S. EPA, Air Pollution Monitoring.

[156] See U.S. EPA, Air Quality Awareness Week 2022: AirNow Fire and Smoke Map Adds New Feature to Improve Accessibility for People with Color Vision Deficiencies. The map uses different symbols for each monitor type.

[157] U.S. EPA, Technical Approaches for the Sensor Data on the AirNow Fire and Smoke Map. See also D. Jaffe, et al., Wildfire and Prescribed Burning Impacts on Air Quality in the United States, J. Air Waste Mgmt. Assoc. 70:6, 583-615 (2020) (data from temporary monitors suggests that "current permanent monitors lack the spatial distribution to fully represent the overall human exposure to wildfire smoke, especially in rural areas").

[158] Wildland Fire Mitigation and Management Comm., On Fire: The Report of the Wildland Fire Mitigation and Management Commission at 101 (Sep. 2023).

State policies that aim generally to improve air monitoring in communities heavily impacted by air pollution might also help increase monitoring capacity for future wildfire smoke emergencies. A new law in *Colorado* (HF 2310, §6) created a pilot grant program for community air monitoring systems that gives priority to projects in environmental justice areas and in areas with high rates of illness associated with exposure to air pollution. *New York's* 2019 Climate Leadership and Community Protection Act (SB 6599) established a community air monitoring demonstration program for communities with potentially high exposure burdens to criteria air pollutants and toxic air contaminants and requires the state to develop a plan for reducing emissions in disproportionately impacted communities.[159] In *California*, 2018 legislation addressed monitoring of air pollution affecting "disadvantaged communities" and "sensitive receptors." The law required the state Air Resources Board to prepare a monitoring plan and to select "the highest priority locations around the state to deploy community air monitoring systems, which shall be communities with high exposure burdens…" The law also requires that any air district containing a location selected by the agency "shall deploy a community air monitoring system in the selected location or locations." Cal. AB 617; Cal. Health & Safety Code §42705.5.

Following are examples of recent state policies that support expanded air quality monitoring capacity with a specific focus on smoke from wildland fires.

Expanding the Permanent Monitoring Network. Providing additional permanent monitors requires a considerable investment not only for obtaining the monitors, but also for longer-term operation and maintenance of the equipment and data management. The high cost of installation, operation, and maintenance is one reason "the existing national system of air quality monitoring networks is limited in reach."[160] EPA provides annual air quality management grants that are used for monitoring, but a recent Government Accountability Office (GAO) report indicated that this funding has decreased over the past two decades.[161]

Oregon has taken steps toward increasing its monitoring network, with funding provided by the state's 2021 wildfire legislation. The law (SB 762 (§13b)) requires the Department of Environmental Quality to "establish and implement a program to support communities across this state in monitoring, interpreting and communicating data related to ambient air quality conditions caused by wildfire smoke." As part of the program, the agency must "[d]eploy air quality monitoring equipment in a manner sufficient to evaluate an increased prevalence of poor air quality attributable to elevated levels of particulate matter." The legislation provided $3.3 million to DEQ during the 2021-2023 biennium for increased monitoring and community response plans. Some of that funding was used to conduct a public outreach survey on monitoring needs and to develop a plan for 20 new additional monitoring sites.[162] In developing the plan, the agency also conducted a gap analysis in coordination with the Oregon Health Authority, which

[159] To implement the law, the Department of Environmental Conservation (DEC) is undertaking monitoring in ten communities. See N.Y. DEC 2022-23 Statewide Community Air Monitoring Initiative.
[160] Wildland Fire Mitigation and Management Comm., On Fire: The Report of the Wildland Fire Mitigation and Management Commission at 101 (2023).
[161] U.S. GAO, Air Pollution: Opportunities to Better Sustain and Modernize the National Air Quality Monitoring System (front matter) (2020). The report recommended that EPA "develop and make public an air quality monitoring modernization plan." Id. at 58.
[162] ELI Communication with Or. DEQ (Dec. 2023).

addressed health equity considerations.[163] If additional funding is provided to DEQ for dedicated staff, the agency intends to deploy, operate, and maintain the planned 20 additional monitoring sites.[164]

Using Portable/Temporary Monitors During Fires. The availability of temporary, portable monitors for use during wildfires is important for communities that are not covered by the permanent monitoring network. Many states maintain temporary air monitors for this purpose.[165] California and Washington have adopted laws in recent years addressing portable monitoring capacity for wildfires and prescribed burns.

- The *California* Air Resources Board (CARB) maintains portable monitors that can be used during smoke events.[166] CARB smoke management regulations for agricultural and prescribed burns require local air district smoke management plans to ensure that "if smoke may impact smoke sensitive areas…smoke management plans…include appropriate monitoring**,** which may include visual monitoring, ambient particulate matter monitoring or other monitoring approved by the district" for specified types of burn projects. 17 Cal. Code Regs. §80160. A 2018 California law aimed to expand the state's capacity for conducting monitoring during prescribed fires, directing CARB to "develop and fund a program, upon appropriation by the Legislature, to enhance air quality and smoke monitoring and to provide a public awareness campaign regarding prescribed burns;" the program may include "purchasing new, rapidly deployable air quality monitors." Cal. SB 1260 §20; Cal. Public Res. Code §4495. The program received $4 million to support "[s]moke monitoring and research to help optimize existing prescribed burn programs."[167]

- The *Washington* Department of Ecology has a suite of temporary monitors that are often added during a wildfire event.[168] The state's 2023 wildfire law requires the Department of Natural Resources to coordinate across agencies, including "coordinating with the department of ecology, local clean air agencies, and the United States forest service to deploy temporary air monitors to assess smoke conditions during prescribed fires and wildfires," as well as conducting "[i]nformation dissemination to the public through online information sources." Wash. HB 1578 §2. Washington's Smoke Management Plan for prescribed fire was revised in 2022 to include "new procedures to avoid, detect, and respond to smoke intrusions…[including]…Using available resources such as monitors and webcams to assess the level of smoke in potentially impacted communities…"[169] DNR has portable monitors/sensors that can be placed near wildfires or in sensitive areas not covered by larger monitors, though agency officials note that areas near prescribed burns typically already have monitors.[170]

[163] ELI Communication with Or. Health Authority (June, Dec. 2023).
[164] ELI Communication with Or. DEQ (Dec. 2023).
[165] See generally U.S. EPA, Comparative Assessment of the Impacts of Prescribed Fire Versus Wildfire (CAIF): A Case Study in the Western U.S. at 4-11 (2021) (noting monitoring efforts for wildfire and prescribed fire in Alaska, Arizona, California Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, and Washington, and by tribes).
[166] Cal. Air Resources Bd., Frequently Asked Questions: Wildfire Emissions.
[167] Cal. Climate Investments, Prescribed Fire and Smoke Monitoring Program. See also Cal. Climate Investments, Prescribed Fire Reporting and Air Monitoring in Shasta County.
[168] See Wash. Dept. of Ecology Tracking Wildfire Smoke; Wash. Dept. of Ecology, Air Monitoring Network.
[169] U.S. EPA, Air Plan Approval: WA Smoke Management Plan Update, 88 FR 17481 (3/23/23).
[170] ELI Communication with Wash. DNR (June 2023, Dec. 2023).

Using Low-Cost Air Sensors to Monitor Indoor Air. EPA defines a low-cost air pollution monitor as "a device that uses one or more than one sensor and other components to detect, monitor and report on specific air pollutants like particulate matter (PM) or carbon dioxide and/or environmental factors such as temperature and humidity."[171] The California Department of Public Health recently summarized the key features of low-cost air sensors, noting that the devices: "Do not replace traditional regulatory monitors…May complement the existing regulatory monitoring network…May be used to identify locations requiring additional monitoring focus…Can collect indoor and outdoor measurements, depending on placement…Can provide backup information when network monitors are unavailable…"[172]

The rapid development and wide availability of low-cost air sensors has enabled a greater number of agencies, organizations, and individuals to conduct air monitoring, both outdoors and indoors. The use of low-cost air sensors inside buildings can "provide feedback data to improve indoor air quality through ventilation, filtration, or other air quality control treatments."[173] The COVID-19 pandemic prompted a surge in the use of air sensors indoors, particularly in schools.[174]

Tribal and local government agencies and non-governmental organizations have developed programs that provide low-cost air sensors for use inside homes or public buildings. For example, the *Bay Area Air Quality Management District* in California received an EPA grant to "deploy a network of outdoor and indoor air sensors and filtration units to community members and schools, who will be trained to interpret data and respond to air quality emergencies, such as wildfire smoke events."[175]

One notable non-governmental air sensor initiative centered around smoke is run by *Clean Air Methow*, which has "placed dozens of low-cost air quality sensors manufactured by 'Purple Air'™ with Clean Air Ambassadors" both indoors and outdoors, across over 100 miles throughout rural Okanogan County, Washington. The project includes information on how to use and interpret the sensors and is part of the organization's broader work to create a smoke-ready community, reduce smoke exposure, and improve air quality.[176] Several jurisdictions recently selected to receive EPA wildfire smoke grants plan to use low-cost air sensors to conduct indoor air quality monitoring.[177]

Although few state policies require indoor monitoring of particulate matter, this may change as consumer-grade devices continue to improve in accuracy and affordability. States also have an important role to play in helping communities use low-cost air sensors and in providing technical guidance to agencies, organizations, and individuals on how to effectively use the devices indoors. As described below, some federal and states agencies have recently developed new materials on the subject.

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[171] U.S. EPA, Low–Cost Air Pollution Monitors and Indoor Air Quality.
[172] Cal. Dept. of Public Health, Wildfire Smoke: Considerations for California's Public Health Officials at 17 (2022).
[173] South Coast AQMD, AQ-SPEC: Air Quality Sensor Performance Evaluation Center.
[174] For examples of school districts using indoor sensors, see Boston Public Schools, Indoor Air Quality Sensor Dashboard; City of Denver, Love My Air; and Montgomery County (MD) Public Schools, Real-Time IAQ Monitoring at Schools.
[175] U.S. EPA, Selections for the ARP Enhanced Air Quality Monitoring Competitive Grant. See also Puget Sound Clean Air Agency, Air Quality Sensors (prioritizing "air pollution and exposure reductions for communities that historically experience challenges to economic opportunity and decision making access in order to champion clean and healthy air for all").
[176] Clean Air Methow, Air Quality; ELI Communication with Clean Air Methow (Jan. 2024).
[177] U.S. EPA, Announcing Anticipated Grant Awardees: Wildfire Smoke Preparedness in Community Buildings Grants.

Developing Technical Guidance on Reducing Smoke Exposure

In addition to providing direct technical assistance, some states affected by wildfire smoke have developed written guidance to help the public and local agencies implement practical recommendations for reducing exposure. *Washington* is notable for having established a working group dedicated to providing technical guidance on wildfire smoke for local health agencies. (See Box.)

Following are examples of recent guidance documents developed by state agencies, mostly without a specific legislative directive. (See Part 3 for examples of state guidance on cleaner air centers.)

Wildfire Smoke Guidance for Local Decision-Making. A number of states have created one- or two-page reference guides to help air quality, public health, and other officials make local decisions about when to cancel activities or take other actions in response to poor air quality conditions. For example, *Washington* has developed the Guide for Public Health Actions for Wildfire Smoke, which provides recommended actions for each of the Air Quality Index color-coded tiers, including steps to protect IAQ, and links to additional resources for more detailed information.[178]

In 2019, the *California* Department of Public Health developed a lengthy guidance document, Wildfire Smoke: Considerations for California's Public Health Officials, in response to recent wildfire smoke episodes. Updated in 2022, the publication covers best practices for reducing exposure, including a section on managing IAQ; tools for public health planning and response, such as assessing community vulnerabilities and establishing community cleaner air shelters and spaces; and links to resources for additional information.[179] As noted earlier, the agency is developing separate guidance to assist local jurisdictions in developing air quality emergency plans, pursuant to AB 619. The state plan must include guidance on how a county informs its residents about the health effects of air pollution, the Air Quality Index, and how an individual can obtain and use protective respiratory and other equipment.

[178] Wash. Dept. of Health, Washington Guide for Public Health Actions for Wildfire Smoke (2023). See also, e.g., Or. Health, Authority, Fact Sheet: Public Health Guidance for School Outdoor Activities During Wildfire Events; Mt. Dept. of Pub. Health & Human Svcs., Outdoor Activity Guidelines Based on Air Quality: Schools and Childcares; Id. Dept. of Health & Welfare, Activity Guidelines for Wildfire Smoke Events.

[179] Cal. Dept. of Public Health, Wildfire Smoke: Considerations for California's Public Health Officials (2022).

The Washington Wildfire Smoke Impacts Advisory Group

The Washington State Department of Health has created a variety of guidance documents related to wildfire smoke. The agency's Wildfire Smoke - Partner Toolkit includes materials on topics such as ventilation, filtration, wildfire smoke and COVID-19, and cooling indoor spaces without air conditioning.

The agency established the Wildfire Smoke Impacts Advisory Group in 2018 to address the need for "more communication resources and greater statewide coordination of messages surrounding wildfire smoke impacts." Washington is a home rule state, and the advisory group is designed primarily to support the wildfire smoke response efforts of local health staff, which comprise most of the group's members along with staff from the state Department of Health. The group includes a smaller number of representatives from other related state and regional agencies, including the Departments of Ecology and Natural Resources, regional clean air agencies, and EPA Region 10. Because it is a working group and not simply a vehicle for sharing informational updates, the voluntary group is limited in size to facilitate discussion.

The mission of the group is developing "consistent messaging and providing fact-based health guidance to agencies that provide resources and recommendations to the public." The group has two key goals: to support development and improvement of evidence-based health guidance for wildfire smoke and to achieve more consistent health messaging across agencies. With a focus on preparedness, the group meets for about eight months a year. Throughout these meetings, the emphasis is on identifying public health needs, as well as allowing a forum for discussion and feedback on how materials developed by the group are being implemented at the local and state levels. This information, in turn, is used by the Department of Health to set future priorities for developing and revising guidance.

Guidance on Using Low-Cost Air Sensors. There are important technical and practical considerations for the effective use of low-cost sensors, including how to ensure accuracy of the device and interpret the data produced.

The Washington Comprehensive Emergency Management Plan states that low-cost air sensors "can be used to take $PM_{2.5}$ measurements indoors to check indoor air quality and outside when there is not a nearby agency monitor during wildfire smoke events," but notes that the sensors are "generally less accurate than agency monitors" and that "[c]orrection factors can sometimes be used to increase accuracy of measured concentrations."[180] The California Department of Public Health suggests that low-cost air sensors can be beneficial in helping determine whether steps to reduce exposure are effective, provided the sensors are accurate, installed correctly, and not influenced by nearby or unintended sources or air pollution…"[181]

[180] Wash. Military Dept., Washington State Comprehensive Emergency Management Plan, ESF 8 Attachment 1 to Appendix 5 – Severe Smoke Episodes (May 2022).
[181] Cal. Dept. of Public Health, Wildfire Smoke: Considerations for California's Public Health Officials at 17 (2022).

A recent study noted that "[r]eliability, maintenance, and ambient relative humidity concerns are larger than with more systematically setup and maintained permanent networks" but that "the public usually does not recognize these issues and can misinterpret the results."[182] To help air sensor users navigate these technical complexities, EPA published the Enhanced Air Sensor Guidebook in 2022. The Guidebook covers selecting, setting up, and using air sensors, as well as analyzing, interpreting, and acting on results.[183] The South Coast Air Quality Management District in California created another resource, the Air Quality Sensor Performance Evaluation Center (AQ-SPEC), to address the problem of "poor quality data obtained from unreliable sensors." AQ-SPEC evaluates the performance of commercially available low-cost air quality sensors and educates the public "about the advantages of such devices and their potential limitations."[184]

At the state level, Washington and California have taken notable actions to provide information on using indoor air sensors.

- The *Washington* Department of Health developed new guidance for schools on how to use sensors indoors and outdoors so as to help schools make decisions about both outdoor activities and how to improve the air quality indoors. The agency undertook an update of two existing guidance documents to add information on air sensors after the Wildfire Smoke Advisory Group identified this as an important need.

  One document, the Wildfire Smoke Guidance for Canceling Outdoor Events or Activities and Closing Schools, was updated to provide detailed information about conducting indoor $PM_{2.5}$ monitoring in schools for situations where decisions about wildfire smoke exposure require some advance planning. The guidance offers steps for measuring indoor $PM_{2.5}$ during a wildfire smoke episode and provides a decision tree for comparing sensor measurements. The agency suggests prioritizing reducing $PM_{2.5}$ levels in rooms with highest levels or relocating children from these rooms to cleaner air spaces, as well as discussing school closure if school is in session and indoor $PM_{2.5}$ concentrations equal or exceed 150.5 $\mu g/m^3$ (corresponding to an AQI value of 201 and to the "Very Unhealthy" or worse categories).[185] The state's Comprehensive Emergency Management Plan echoes and references this information.[186]

[182] D. Jaffe, et al., Wildfire and Prescribed Burning Impacts on Air Quality in the United States, J. Air Waste Mgmt. Assoc. 70:6, 583-615 (2020) (citations omitted). See also U.S. GAO, Science & Tech Spotlight: Air Quality Sensors (noting that low-cost sensors "operate with fewer quality assurance measures than government-operated sensors and vary in the quality of data they produce"); W. Delp & B. Singer, Wildfire Smoke Adjustment Factors for Low-Cost and Professional $PM_{2.5}$ Monitors with Optical Sensors, Sensors 20(13), 3683 (2020).

[183] U.S. EPA, How to Use Air Sensors: Air Sensor Guidebook. See also South Coast AQMD, AQ-SPEC: Air Quality Sensor Performance Evaluation Center; Lawrence Berkeley National Lab., Indoor Air Sensors. EPA also provides a guide to siting and installing sensors, including considerations for indoor air sampling. U.S. EPA, A Guide to Siting and Installing Air Sensors.

[184] South Coast AQMD, AQ-SPEC: Air Quality Sensor Performance Evaluation Center.

[185] Wash. Dept. of Ecology and Wash Dept. of Health, Wildfire Smoke Guidance for Canceling Outdoor Events or Activities and Closing Schools (2023).

[186] Wash. Military Dept., Washington State Comprehensive Emergency Management Plan, ESF 8 Attachment 1 to Appendix 5 – Severe Smoke Episodes at ESF 8-5-9 (2022).

Air sensor information was also added to a second Washington Department of Health guidance document, Children and Youth Activities Guide for Air Quality, which provides public health recommendations to protect children and youth from $PM_{2.5}$. The document now includes a two-page appendix with guidance on using sensor data for "immediate decision-making," covering when and how to take measurements, the ways in which sensor measurements can vary, and how to compare and interpret the data produced, with a link to EPA's calculator for converting between $PM_{2.5}$ concentrations and AQI values. The guidance notes that "[d]uring smoke periods, the threshold of 35.5 µg/m^3 is a useful target of indoor concentration (the lower the better)" and recommends limiting indoor activities to light intensity if indoor $PM_{2.5}$ levels are elevated.[187] The 35.5 ug/m^3 threshold corresponds to the lower limit of the AQI "unhealthy for sensitive groups category."

- The *California* Air Resources Board is funding a project, Low-Cost Sensors for Healthier Indoor Air Quality in Impacted Communities, that will develop a white paper and "actionable guidance for impacted communities to reduce exposure to indoor air pollutants" using low-cost sensors. The project will provide detailed information about low-cost air sensors available for IAQ monitoring; step-by-step instructions on sensor selection, setup, deployment, and maintenance; a detailed description about how to handle sensor data; and a description of typical indoor air pollution scenarios such as wildfire smoke, with special considerations for IAQ monitoring and methods to reduce exposures. The project is expected to be completed in September 2024.[188]

Guidance on Ventilation and Filtration. During the COVID-19 pandemic, numerous agencies and organizations disseminated information on how to use high-efficiency filters and portable air cleaners to reduce indoor exposure to infectious aerosols.[189] Some states have developed technical guidance on ventilation and filtration specifically related to wildfire smoke.

- For example, in 2022, the *Washington* Department of Health published Improving Ventilation and Indoor Air Quality During Wildfire Smoke Events: Recommendations for Schools and Buildings with Mechanical Ventilation, which provides sections on portable air cleaners and on upgrading and maintaining HVAC filters. The agency has also created a Smoke from Fires FAQ page that includes fairly detailed information on those topics.[190]

[187] Wash. Dept. of Health, Washington Children and Youth Activities Guide for Air Quality (2023). Two other short appendices address outdoor air monitoring and improving IAQ. See also Wash. Dept. of Health, FAQs: Washington Children and Youth Activities Guide for Air Quality (2023).
[188] Cal. Air Resources Bd., Low-Cost Sensors for Healthier Indoor Air Quality in Impacted Communities; ELI Communication with Cal. Air Resources Bd. (Oct. 2023). Idaho is another state that has created a short document explaining the basics of low-cost air sensors. Id. Dept. of Env. Quality, Low-Cost Air Sensors: FAQS.
[189] See, e.g., U.S. EPA, Air Cleaners, HVAC Filters, and Coronavirus (COVID-19); Il. Dept. of Health, Ventilation, Filtration, and Air Cleaning Guidance; Harvard School of Public Health, Portable Air Cleaners: Selection and Application Considerations for COVID-19 Risk Reduction – Healthy Buildings.
[190] See Wash. Dept. of Health, Improving Ventilation and Indoor Air Quality During Wildfire Smoke Events: Recommendations for Schools and Buildings with Mechanical Ventilation (2022); Wash. Dept. of Health, Smoke From Fires.

- The *California* Air Resources Board provides a web page devoted to information on Indoor Air Cleaners and Wildfire Smoke.[191]

- States such as *Oregon*, *Washington*, and *California* provide instructions and information on DIY filters, which are important for households that cannot purchase commercial air cleaners to reduce wildfire smoke exposure.[192] Numerous tribes, local governments, academic institutions, and other non-governmental organizations also provide written information and instructional videos on DIY filters in connection with wildfire smoke.[193] These programs and materials typically involve a single-filter design, though some provide information about models using multiple filters.

Occupational Safety and Health Guidance. In addition to providing technical guidance to building owners and managers generally, some states have recently created guidance on indoor wildfire smoke exposure designed specifically for employers.

- The *California* Division of Occupational Safety and Health (Cal/OSHA) created Protecting Indoor Workplaces from Wildfire Smoke with Building Ventilation Systems and Other Methods, which describes employer responsibilities and how to use HVAC system filters to reduce exposure to wildfire smoke.[194] (Section 5 describes the Cal/OSHA wildfire smoke rule.)

- The *Montana* Department of Public Health and Human Services' Asthma Control Program has also developed wildfire smoke guidance specifically for employers and employees, which states: "Employers should be aware that wildfire smoke may adversely affect the health of their workforce and prepare to take action to limit their workers' exposures when wildfire smoke is impacting a work environment."[195] The guidance, Wildfire Smoke & Employee Health, includes "10 Elements of a Smoke Readiness Plan" for commercial buildings, which summarizes and references the recent ASHRAE guidance on reducing indoor exposure to wildfire smoke, Planning Framework for Protecting Commercial Building Occupants from Smoke During Wildfire Events.[196] The Asthma Control Program has also worked with the state Department of Labor and Industry (DLI) to coordinate a training during the DLI's Summer Safety Fest on the ASHRAE recommendations and standards and the importance of indoor air quality.[197]

[191] Cal. Air Resources Bd., Indoor Air Cleaners and Wildfire Smoke FAQ.
[192] Or. Health Authority, Fact Sheet: Do It Yourself (DIY) Air Filter (2020); Wash. Dept. of Health, Smoke From Fires; Cal. Air Resources Bd., Smoke Ready California.
[193] See, e.g., Puget Sound Clean Air Agency, DIY Air Filter; Mendocino County Air Quality Mgmt. District, Clean Indoor Air During Wildfires: How To Make Your Own HEPA Air Purifier; Colville Tribes Air Quality Program, Box Fan Filter: A DIY Users Guide; Climate Smart Missoula, DIY Fan/Filter Combos; UConn Indoor Air Initiative, Build Your Own.
[194] Cal. Dept. of Industrial Relations, Protecting Indoor Workplaces from Wildfire Smoke with Building Ventilation Systems and Other Methods.
[195] Mt. Dept. of Health and Human Svcs., Wildfire Smoke & Employee Health.
[196] See Part 1 of this report for a description of the ASHRAE document, Planning Framework for Protecting Commercial Building Occupants from Smoke During Wildfire Events.
[197] ELI Communication with Mt. Dept. of Public Health & Human Svcs. (July 2023).

Conducting Notification and Outreach for Prescribed Burns

Because prescribed burns are planned in advance, there is an opportunity for potentially affected communities to avoid scheduling outdoor events and take other steps to reduce indoor exposure to smoke during the burn, but only if they have timely information. In describing its smoke management program, the Oregon Department of Environmental Quality notes, "Although prescribed fires are planned to occur during atmospheric conditions that limit smoke impacts, nearby communities may experience unintended smoke, therefore educating community members about smoke hazards and how to protect themselves is an important part of smoke management."[198]

In addition to providing advance notice of the timing and scope of a prescribed fire and any updates or changes to the burn plan, outreach could include information about smoke health risks and how community members can minimize exposure.[199] States have developed a variety of educational materials and resources related to prescribed burns. One example is the *California* Smoke Spotter, a mobile app created by the Air Resources Board in 2021 to support the state's policy increasing the use of prescribed fire. The original purpose of the app was to "help the state balance air quality protection with fire protection and land management goals" by providing forecasts of smoke from prescribed fires and tips on how people could protect themselves from smoke. The app was later expanded to help people protect themselves from wildfire smoke with new information such as personalized alerts for new wildfires, next-day wildfire smoke forecast for localities statewide, wildfire details (e.g., size, containment and lead firefighting agency), and AQI data from PurpleAir sensors showing real-time smoke conditions.[200]

State smoke management rules, plans, and programs are key policy tools for ensuring that communities receive information about prescribed burns and smoke risks in a timely and meaningful way. EPA regulations provide important context for the development of smoke management policies.

EPA's Exceptional Events Rule

The Clean Air Act directs EPA to adopt regulations "governing the review and handling of air quality monitoring data influenced by exceptional events." 42 U.S.C. §7619(b). The agency's Exceptional Events Rule was promulgated in 2007 and revised in 2016. 40 C.F.R. §50.14; 81 Fed. Reg. 68,216. The rule sets forth "criteria and procedures for use in determining if air quality monitoring data has been influenced

[198] Or. DEQ, Smoke Management for Prescribed Burning on Forestlands.
[199] See J. Sacks, et al., At the Intersection: Protecting Public Health from Smoke While Addressing the U.S. Wildfire Crisis, Am. J. Respir. Crit. Care Med., 208:7 at 756 (2023) (suggesting the need for increasing awareness to when and where prescribed fires occur and potential health risks of smoke, as well as measures to take to avoid prescribed fire smoke exposure); Cal. Dept. of Public Health, Report on Listening Sessions with Community Members, El Dorado and Nevada Counties, California at 28, 32 (2021) (finding that the "overall sentiment from participants was that current messaging about prescribed fire was insufficient" and that participants want to know when and where a prescribed burn would occur, who would conduct and oversee it, and the window of time when smoke would be present).
[200] Cal. Air Resources Bd., California Air Resources Board Releases California Smoke Spotter 2.0.

by exceptional events," including wildfires and prescribed fires, and thus may be excluded in determining compliance with NAAQS.[201]

Under the rule, EPA will exclude data from a prescribed fire or wildfire if the state demonstrates to EPA's satisfaction that those emissions "caused a specific air pollution concentration in excess of one or more national ambient air quality standards at a particular air quality monitoring location and otherwise satisfies the requirements" of the rule. 40 C.F.R. §§50.14(b)(3)(i),(4). A state seeking to exclude air quality data due to exceptional events must take specified actions to protect public health from exceedances or NAAQS violations:

> (1) Provide for prompt public notification whenever air quality concentrations exceed or are expected to exceed an applicable ambient air quality standard; (2) Provide for public education concerning actions that individuals may take to reduce exposures to unhealthy levels of air quality during and following an exceptional event; and (3) Provide for the implementation of appropriate measures to protect public health from exceedances or violations of ambient air quality standards caused by exceptional events. 40 C.F.R. §51.930(a).

For prescribed burn air quality data to be excluded, a state must either certify that it has adopted and is implementing a smoke management program or must demonstrate that the burn manager employed appropriate basic smoke management practices set forth in the rule. These smoke management practices include communication and public notification of neighbors and "those potentially impacted by smoke, especially sensitive receptors." 40 C.F.R. §50.14 (b)(3)(ii)(A), Table 1.[202] Thus, for jurisdictions seeking to exclude prescribed fire monitoring data, EPA rules require public notification and other smoke management practices, though the rules do not specify how notification is to be carried out.

State Policies Addressing Notification and Outreach around Prescribed Burns

State smoke management policies typically include provisions for notifying and/or educating communities potentially affected by prescribed fire. These provisions vary in the specific measures they establish and in whether the measures are mandatory or recommended.[203] Following are examples from several smoke management rules and plans.

- *Alaska's* enhanced smoke management plan for regional haze requires applicants to identify the location of all sensitive features that might be impacted by smoke and to indicate how the public will be informed prior to, during, and after a burn. The plan also states, "Every effort should be made by the Responsible Authority to involve the potentially affected community in an early and on-going discourse on the use of prescribed fires in their area." The plan also states that the Department of

[201] See U.S. EPA, Treatment of Air Quality Data Influenced by Exceptional Events. EPA has published agency guidance around exceptional events determinations for wildfires and prescribed fires. U.S. EPA, Exceptional Events Guidance (2016); U.S. EPA, Prescribed Fire Final Guidance (2019).

[202] In addition, a state that has "areas with historically documented or known seasonal events" (three events in a three-year period), must submit a mitigation plan for those areas that includes public notification and education programs, mitigation measures, and periodic review and evaluation of the plan. 40 C.F.R. §51.930(b). According to a recent GAO report, as of April 2022, EPA had identified 15 such areas in California, Colorado, Montana, and Nevada." U.S. GAO, Wildfire Smoke: Opportunities to Strengthen Federal Efforts to Manage Growing Risks at 18 (2023)

[203] See generally National Wildfire Coordinating Group, NWCG Smoke Management Guide for Prescribed Fire at 106 (2020)(noting the broad range of approaches to smoke management around the country).

Environmental Conservation "will notify health authorities, news media, the public-at-large, land management agencies, and all other appropriate agencies when unacceptable limits of smoke accumulation are approached or exceeded."[204]

- One of the stated purposes of *Oregon's* smoke management rules is to "educate the public as to the necessity of prescribed burning and the measures being taken to protect air quality, public health and visibility." Or. Admin. Code §629-048-0010. The rules require the Department of Forestry to develop and distribute a best-practices communication framework for dissemination to local public health authorities that includes general information about: "(a) The purpose and importance of prescribed burning, (b) The health risks of wildfire and prescribed fire smoke, (c) Recommendations for the public and vulnerable populations to reduce their exposure to smoke, (d) How local officials and the public can find out about current and upcoming prescribed burns planned in their area, and (e) How residents of [sensitive areas] and other interested persons can get up-to-date information about anticipated smoke impacts..." [205] Or. Admin. Code §629-048-0180. As described above in Section 1, Oregon's smoke management rules provide an incentive for local jurisdictions to adopt community response plans, and the rules include public notification, communications, and education as elements of a CRP. Annual reports on local CRP implementation must include, among other things, "a summary of methods used to communicate to the public and vulnerable populations." Or. Admin. Code §§629-048-0180(2), (3)(f).

- Under *Washington's* smoke management plan, multiple-day burns require communication plans, including "outreach to targeted audiences," submitted at least three months in advance for review by the Department of Natural Resources. If DNR "determines that the burn has the potential to affect communities, the burner must notify the public of the burn at least one week before they plan to burn," through local newspapers, traditional broadcast media, or social media. The notice must "list the location, size and duration of the burn, and must include a landowner's phone number to call for updates or more information about the burn." The smoke management plan also sets forth the procedures DNR will follow to coordinate with other agencies to provide public notifications or health advisories in the event of a smoke intrusion; the plan sets the $PM_{2.5}$ threshold for a smoke intrusion at 20.5 $\mu g/m^3$, the state's 24-hour average concentration for protecting sensitive individuals.[206]

- In *Colorado*, if the state air quality agency determines that a proposed prescribed burn poses a high smoke risk, the agency is to issue a draft permit for public comment and "provide appropriate notice to the public, such as by making the information available through the internet and by email." The notice must include "information about location of the fire, expected burn dates, expected duration, potential emissions, potential air quality and visibility impacts at smoke sensitive receptors and the opportunity for public comment." 5 Co. Code Regs. §§1001-11:V(F), VI(E).

- *Utah's* smoke management plan assigns responsibility for public notification and education to certain parties involved in prescribed burns. Under the plan, information about recent, current, and upcoming prescribed fire projects, including smoke impacts, is a shared responsibility of the state

[204] Ak. Dept. of Envtl. Cons., Alaska Enhanced Smoke Management Plan at 7, 9-10 (2015).
[205] See Or. Dept. of Forestry, Smoke Management Rules Statewide Communications Framework In the Context of COVID (2022).
[206] Wash. DNR, Smoke Management Plan - 5.10.2022 at 11, 33.

> smoke management coordinator and land managers conducting prescribed burns. Land managers are responsible for providing information about the role of prescribed fires and wildfires in accomplishing land management objectives, while education about the health effects of smoke is the responsibility of the coordinator and the state Division of Air Quality.[207]

Smoke management policies may also address how state agencies and burners will respond to public complaints about smoke from an approved burn, and some states have established complaint processes. For example, the policy of the *Oregon* Department of Forestry is that complaints "shall be investigated, appropriately treated, recorded, and the complainant informed of the investigation results in a timely…courteous, and professional manner." The agency defines a complaint as "any report of smoke alleged to be from forestry activity that may adversely impact public health or protected visibility" and has developed an online complaint form. Complaint investigation data is reported periodically in accordance with the state's smoke management rules.[208] The *Washington* Smoke Management Plan sets forth procedures for processing a complaint, and the Department of Natural Resources recently established a smoke complaint form on the agency's smoke portal. The form may be submitted anonymously or with contact information that the agency can use to follow-up with the person submitting the complaint.[209]

[207] State of Utah, Utah Smoke Management Plan at 8 (rev. 2021).
[208] Or. Dept. of Forestry, Prescribed Forest Burning – Slash Pile Smoke Complaint.
[209] Wash. DNR, Smoke Management Plan 05.10.2022 at 15-16; Wash. DNR, New Smoke Complaint.

Section 3: Cleaner Air Center Policies

An important function of government during wildfire smoke episodes and other emergencies is to provide temporary relief for those who do not have another place where they can safely shelter indoors. EPA's Wildfire Smoke Guide recommends that public health officials "identify and evaluate public spaces where people can seek relief from wildfire smoke." These cleaner air centers are usually located in publicly owned buildings such as libraries or community centers, though they may also be set up in private spaces that are open to the public. In contrast to shelters that are operated around the clock for people displaced by wildfires, cleaner air centers make use of existing facilities that are open to the public for a portion of the day and that are equipped to reduce smoke inside the building. They may be integrated with facilities that provide respite from other emergencies, such as heat waves and power outages.

This section highlights recent state policies and programs in California and Oregon that established new funding programs for equipping local cleaner air centers and describes California guidance documents outlining considerations for setting up and operating such facilities.

Funding Cleaner Air Centers

Financial and logistical planning for cleaner air centers involves addressing a number of practical challenges that people may face in using the facilities. People in need of protection from wildfire smoke may be unaware that there is a cleaner air center, may lack transportation to the facility, or may be unwilling to go to an unfamiliar place or to leave their pets at home. People who lack housing, older adults, and people with disabilities may face additional barriers to using cleaner air centers.[210] Thus, the costs involved in providing cleaner air centers can be considerable. In addition to operating expenses such as staffing, supplies, and transportation, upfront costs include selecting appropriate locations, training staff, conducting public outreach, and improving IAQ through HVAC upgrades, filter replacement, and/or portable air cleaner purchases.[211]

[210] A recent review of cleaner air center use in one California county found that facilities were under-used due largely to a lack of amenities and residents' attachment to their homes or belongings, particularly unhoused individuals and rural residents. See generally, R. Treves, et al., Wildfire Smoke Clean Air Centers: Identifying Barriers and Opportunities for Improvement from California Practitioner and Community Perspectives, Soc. & Nat. Res., 36:9, 1078-1098 (2022) (discussing findings from interviews conducted with local officials and members of a community disproportionately impacted by smoke due to socioeconomic factors). See also Sacramento County Public Health, et al., Wildfire Smoke Air Pollution Emergency Plan for Sacramento at 29 (2022); E. Mallen, et al., Extreme Heat Exposure: Access and Barriers to Cooling Centers — Maricopa and Yuma Counties, Arizona, 2010–2020, MMWR Weekly 72:926–932 (2023).

[211] See Sacramento County Public Health, et al., Wildfire Smoke Air Pollution Emergency Plan for Sacramento at 29-30 (2022). Sacramento's Wildfire Smoke Plan recommended expanding state grant programs to cover these costs and also suggested that local jurisdictions "actively establish partnerships with volunteer organizations that are willing to assist by providing facilities, staff and supplies during an event," noting that such partnerships could

Local government agencies and tribes play a leading role in setting up and operating cleaner air centers in their communities. For example, *Multnomah County, Oregon*, has partnered with Portland Public Schools "to evaluate the opportunities and barriers for using schools as clean air and cooling shelters during periods of smoke and extreme heat."[212] The city of *Seattle* implemented a pilot project in 2019 to provide community centers with high-efficiency filtration systems and more recently announced the availability of $2.4 million for identifying and developing "resilience hubs."[213] The development of resilience hubs is a strategy for creating community-designed facilities that can both serve as emergency spaces and meet local needs year-round.[214]

Federal agencies programs may be potential sources of funding for local cleaner air shelters. For example, the Federal Emergency Management Administration (FEMA) operates sheltering support programs that provide assistance to state, local, tribal, and territorial governments after the issuance of a presidentially declared emergency or a major disaster declaration. FEMA may provide "equipment, materials, supplies, and personnel to support disaster-affected jurisdictions in providing life-sustaining services in congregate and non-congregate facilities that provide a secure and sanitary environment for displaced survivors."[215] The Department of Housing and Urban Development's Community Development Block Grant (CDBG) program is another potential source of funding. A 2021 HUD memo explained how "states and cities may use CDBG funds to provide public facilities and services to prepare for and respond to extreme heat events."[216] HUD has also published a Community Resilience Toolkit "to help recipients of HUD Community Planning and Development (CPD) funds identify opportunities to use their CPD dollars to mitigate the impacts of natural related hazards."[217]

State and local emergency management agencies implement ongoing emergency shelter programs that might be utilized to support cleaner air spaces for wildfire emergencies. In 2023, *Washington* legislation appropriated funds to the Military Department, the state's emergency management agency, to "administer grants to local governments and federally recognized tribes for costs to respond to community needs during periods of extremely hot or cold weather or in situations of severe poor air quality from wildfire smoke." Recipients must "be located in a geographic area where vulnerable populations face combined, multiple environmental harms and health impacts, as determined by the department." The grants may be used to reimburse the costs of "activities necessary for life safety during

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reduce the overall cost and help in "communicating with and persuading vulnerable persons to use cleaner air facilities or accept assistance." Id.

[212] Multnomah County, Office of Sustainability, Portland Public Schools & Multnomah County Team up with the EPA to Explore How to Make Schools More Climate Resilient (10/19/23).This project received funding from EPA's Schools as Community Cleaner Air and Cooling Centers program.

[213] Seattle Office of the Mayor, Mayor Harrell Announces $6.5 Million in 2022 Green New Deal Opportunity Fund (9/7/22). See also Seattle Office of the Mayor, To Protect Vulnerable Communities…City of Seattle Upgrades Community Centers, Seattle Center Buildings with HVAC and Air Filtration Systems (6/18/19).

[214] Urban Sustainability Directors Network, Resilience Hub Series: What is a Resilience Hub?.

[215] FEMA, Sheltering Support; FEMA, Emergency Support Function #6 – Mass Care, Emergency Assistance, Temporary Housing, and Human Services Annex.

[216] HUD, FAQs: CDBG Resources and Authorities to Help Pacific Northwest Communities Respond to Heat Waves and Extreme Temperature Events (2021).

[217] HUD Exchange, HUD Community Resilience Toolkit.

a period of extremely hot or cold weather or in situations of severe poor air quality from wildfire smoke, as determined by the department." Wash. SB 5187 §148(11).

Two other states – California and Oregon – enacted legislation creating larger pilot programs within their air quality and human services agencies to fund the establishment of local cleaner air centers for wildfire smoke emergencies.[218]

California's Wildfire Smoke Clean Air Centers for Vulnerable Populations Incentive Pilot Program

Legislation. In 2019, California legislation created a grants program focused specifically on wildfire cleaner air centers. Cal. AB 836; Cal. Health & Safety Code §39960(a)(1). The following year, budget legislation (SB 74) provided $5 million to the California Air Resources Board to fund and administer the program. According to AB 836, the purpose of the Wildfire Smoke Clean Air Centers for Vulnerable Populations Incentive Pilot Program is "to create a network of clean air centers, where vulnerable populations can find respite from wildfires and other smoke events."

Program Criteria. Eligible applicants include schools, community centers, senior centers, and sports centers, which may use the funding to (1) upgrade facility HVAC systems, (2) purchase high-efficiency air filters for HVAC systems (five years of filter replacements), or (3) purchase portable air cleaners (with five years of filter replacements).

AB 836 required CARB to develop program guidelines in consultation with air districts, local governments, school districts, and other stakeholders. The guidelines were to address capacity, location relative to vulnerable populations, and ventilation/IAQ, and to prioritize projects located in areas "with documented high cumulative smoke exposure burden" and schools that serve pupils from low-income families.[219] The guidelines give higher priority in the selection process to facilities that are located in "low-income schools," are "close to and provide easy access for vulnerable populations," "have a reasonable capacity to meet the possible clean air center needs of vulnerable populations," and "are ready for ventilation and filtration installation, upgrades, or retrofits." Facilities must be located in an area that has had multiple days at or above an AQI value of 151 due to wildfire smoke in the past five years or has been identified as a heavily impacted area by air districts, based on wildfire smoke health advisory notices announced in the past five years.[220]

One limitation of the program is that grants cannot be used for operating costs. This could pose an obstacle if facilities have to extend their hours or otherwise alter their operations, as facilities selected for funding must be able to provide access to the public during wildfires and other smoke events.[221]

[218] Some jurisdictions that recently were awarded EPA wildfire smoke grants plan to use the funding to equip buildings as cleaner air centers. U.S. EPA, Announcing Anticipated Grant Awardees: Wildfire Smoke Preparedness in Community Buildings Grants. For example, the Montana Asthma Control Program will use this funding to, among other things, create a clean air shelter recognition program implemented initially in select communities and later refined for wider use. The project will also include strategies to educate the public on how to protect and improve IAQ in their homes. ELI Communication with Mt. Dept. of Public Health & Human Svcs. (July 2023).

[219] Cal. Air Resources Bd., Wildfire Smoke Clean Air Center Grant Guidelines (rev. 2022).

[220] Cal. Air Resources Bd., Wildfire Smoke Clean Air Center Grant Guidelines at 10-11 (rev. 2022).

[221] Id. at 11.

Implementation. Program funding is distributed by regional air pollution control districts, which have flexibility in weighing local considerations regarding placement of the funded clean air centers to provide access for vulnerable communities in the area; CARB reviews and approves applications selected by the air districts to ensure that the proposed projects meet the program requirements.[222] CARB allocated the bulk of the program's funding to three air districts: the Bay Area Air Quality Management District ($3 million), the San Joaquin Valley Air Pollution Control District ($750,000), and the South Coast Air Quality Management District ($250,000). The remaining funds ($1 million) were provided to the California Air Pollution Control Officers Association (CAPCOA), which in turn has distributed the funding among the other air districts across the state, including a number of small and medium-sized districts with varying levels of staffing and resources.[223]

According to program officials, around 95 percent of the funding had been spent as of November 2023. Most of the funding has been used for the purchase of air cleaners, some of which are at fixed locations, and some will be provided at locations to be determined during a future emergency. For example, the South Coast AQMD bought 200 portable air cleaners, and they are working with the Red Cross to coordinate where the units are deployed.[224] Grant recipients are required to submit an annual report (including, e.g., dates of operation, equipment deployed, and usage of facilities) for five years, followed by a final assessment report (including, e.g., program evaluation, recommendations on facility selection, facility upgrade, facility operation, and public outreach).[225] The Bay Area AQMD used its $3 million in program funding to supplement other funds to create a network of 331 clean air centers in the Bay Area region. As of July 2023, the program had delivered 1,042 portable air cleaners with filter replacements and was supporting an HVAC upgrade at a local library.[226]

CARB plans to launch in early 2024 an online mapping tool that the public can use to get clean air center location and operating information, and the agency may integrate information about the facilities into its Smoke Spotter mobile app in the future. Using discretionary funds, CARB has developed and distributed public communications materials, including banners and signage with a recognizable logo that a facility can use to alert the public that it is a clean air center.[227]

California's Funding for Community Resilience Centers

In 2022, the California legislature established the Community Resilience Center Program, a competitive grant program for nonprofits, local agencies, and tribal governments "for the construction of new, or the retrofitting of existing, facilities that will serve as community resilience centers…[that] serve as community emergency response facilities and aid in building long-term resilience, preparedness, and recovery operations for local communities." Cal. AB 211 §28; Cal. Pub. Res. Code §75250(b).

Funded community resilience centers (CRCs) must provide services and amenities on a year-round basis, which may include "cooling, clean air, respite, community evacuation and emergency response, and other services to mitigate the public health impacts of extreme heat and other emergency situations

[222] Id. at 15.
[223] Id. at 9.
[224] ELI Communication with Cal. Air Resources Bd. (November 2023).
[225] Cal. Air Resources Bd., Wildfire Smoke Clean Air Center Grant Guidelines at 17 (rev. 2022).
[226] Bay Area AQMD, Board of Directors Meeting Nov. 1, 2023 at 42. Bay Area AQMD, Bay Area Clean Air Centers.
[227] ELI Communication with Cal. Air Resources Bd. (Nov. 2023).

exacerbated by climate change, such as wildfire, poor air quality, power outages, or flooding, on local populations." The state's Strategic Growth Council was charged with developing program guidelines that prioritize projects located in under-resourced communities and that include both rural and urban communities.

The Council has published guidelines for the first round of funding, which will provide planning, project development, and implementation grants.[228] Implementation grants must incorporate at least four of seven strategies listed in the guidelines. One strategy, air quality and public health, aims to "[b]uild or enhance the CRC's capacity to provide clean air during emergency activations and year-round..." Allowable expenses include:

- Filtration upgrades to heating, ventilation, and cooling (HVAC) systems.
- HVAC system replacement.
- Air filtration and purification appliances.
- Outdoor cooling solutions and heat reflective measures.
- Passive cooling retrofits and fans.
- Equipment for public health, COVID-19 related needs, and airborne pathogens.
- Indoor and outdoor air monitors.

Other eligible program activities include "culturally and linguistically appropriate education" on topics that include "tracking indoor and outdoor air quality, asthma, and public health impacts."[229]

Oregon's Cleaner Air Center Grant Program

Oregon's 2019 executive order creating the Governor's Council on Wildfire Response stated that "a sufficient number of smoke-free shelters need to be provided, and all citizens must be properly educated about how to find relief from the smoke." Or. Exec. Order 19-01. In 2021, Oregon's comprehensive wildfire legislation addressed this need directly.

Legislation. The 2021 legislation created a new cleaner air center grant program and included over $5 million for the program for the biennium ending June 30, 2023. Or. SB 762 §§14, 57. In 2022, the legislature expanded the program to add warming and cooling shelter assistance, listed additional criteria for the program, and added $2 million. Or. SB 1536 §§30-32.

Under the legislation, the Oregon Department of Human Services (ODHS) is designated as the lead agency for supporting cleaner air center operations and for running the grant program, in coordination with the Oregon Health Authority. The purpose of the grant program was to allow local agencies to establish emergency spaces for clean air, warming, or cooling at no charge to the public, including equipping public buildings with "[s]moke filtration systems so the public buildings may serve as cleaner air spaces during wildfire smoke and other poor air quality events." Or. SB 762 §14; Or. Rev. Stat. §431A.410. The program web page clarified that the funded facilities did not need to be open overnight

[228] Cal. Strategic Growth Council, Community Resilience Centers (CRC) Program Round 1 Final Program Guideline FY2022-2023 at 20 (Dec. 2023).
[229] Cal. Strategic Growth Council, Community Resilience Centers (CRC) Program Round 1 Final Program Guideline FY2022-2023 at 20 (Dec. 2023).

and that grantees were required to notify the state's 2-1-1- system as to the facilities' hours and dates of operation.[230]

Program Criteria. According to program materials, eligible recipients included local governments, tribes, and public education providers, with applications prioritized based on the historic smoke trends identified in the Oregon DEQ's Wildfire Smoke Trends and Air Quality Index. Grant funds could be used for "initial program startup costs, purchase and installation of air filtration system improvements, [and] set up and improvement of warming, cooling and cleaner air spaces." For applications that included changes to a structure, ODHS offered to make available contracted industrial hygienists to provide technical assistance in identifying IAQ improvements in the spaces.[231]

Implementation. Applications from eligible entities were evaluated and scored based on a standardized set of criteria, including elevated AQI, CDC Social Vulnerability Index score, population density, and the rural/frontier/urban area designation of the proposed shelter location. According to the agency, applicants who were "located in rural or frontier area designations with the most hazardous AQI, highest social vulnerability, highest population density and highest capacity of the proposed shelter received higher scores."[232]

The agency awarded over $4 million in grants to 26 recipients across 16 counties, with grants ranging from under $1,000 to $250,000. Over half of the award recipients were public education providers; 17 represented rural areas, eight represented frontier areas, and three represented urban areas."[233]

The program also spent over $3.5 million in funds for "operational expenditures and equipment purchases." Some of this funding was used to purchase 463 air cleaners and 11 mobile HVAC trailers to be kept in storage facilities across the state in strategic areas "to improve the efficiency of response times" in rural and frontier areas, as well as 326 air cleaners that were sent to communities across the state for use "during any poor air quality event in order to open a shelter for public access." The purchases addressed potential barriers posed by procurement processes and construction delays that could prevent communities from receiving assistance quickly.[234]

In its report to the legislature, ODHS estimated the unmet need for cleaner air center funding at around $18 million. The agency recommended areas for improving the program in the future, including adding strategic planning, record keeping, and data management components; providing funding for equipment acquisition, coordination, and deployment of staff and resources during emergencies; and allowing K-12 public schools to waive the requirement that shelters be open to the public.[235]

[230] Or. Dept. of Human Svcs., Grants and Supports for Emergency Shelter.
[231] Id. See also Or. Dept. of Human Svcs., Shelter Grants (2022).
[232] Or. Dept. of Human Svcs., 2023 Legislative Report: Senate Bill 762 and Senate Bill 1536 at 9 (2023).
[233] Id. at 9-12. The agency also noted that some public education providers were reluctant to apply and accept grant funding due to the requirement that the shelter be open to the general public. Id at 22.
[234] Id. at 5-6.
[235] Id. at 22.

Providing Technical Guidance for Creating and Operating Cleaner Air Centers

In addition to providing funding, states could support local agencies and organizations by providing guidance on best practices for setting up and operating cleaner air centers. In addition to outlining strategies for improving indoor air quality, such guidance can address siting, outreach, and operating practices that enable full access by community members most impacted by smoke, including people with disabilities and those with limited transportation options.

EPA's Wildfire Smoke Guide discusses ventilation and filtration considerations for cleaner air centers.

> At a minimum, a cleaner air shelter should have central air conditioning with filtration that is at least medium or high-efficiency, particularly at the fresh (outdoor) air intake(s). If needed, filters should be upgraded prior to the fire season after assuring that the system can handle the increased airflow resistance. Building managers should ensure that filters are properly fit and sealed to prevent air bypassing the filter media. Filters should be regularly maintained and/or replaced according to the manufacturer's recommendations. Even during smoke events, building managers should continue to ensure that the building is adequately ventilated and that fresh air intakes have high-efficiency (MERV 13 or higher) filters to clean the air entering the building...
>
> Install/inspect room air cleaners where appropriate, such as in cleaner air shelters with separate, smaller rooms (e.g., classrooms, meeting rooms). Choose room air cleaners with sufficient capacity, i.e., a tobacco smoke Clean Air Delivery Rate (CADR) that is at least 2/3 the floor area. Choose an air cleaner with a higher CADR for rooms with ceilings higher than 8ft. Ensure proper maintenance of air cleaners, keep spare filters on hand, and provide instructions on changing the filter to trained personnel.[236]

EPA's web pages include information about special considerations for operating cleaner air centers during infectious disease emergencies such as COVID-19: "Increasing indoor air filtration may help to reduce the concentration of both smoke particles and SARS-CoV-2 when additional ventilation with outdoor air is not possible. Cleaner air shelter managers will need to balance the potential tradeoff between exposures to wildfire smoke and SARS-CoV-2 by monitoring indoor and outdoor conditions and adjusting ventilation and filtration approaches as appropriate."[237]

In 2021, EPA launched a pilot project, Schools as Community Cleaner Air and Cooling Centers, which has developed fact sheets for building managers, administrators, teachers, and parents/caregivers on upgrading school facilities for mitigating wildfire smoke and extreme heat.[238] The program has also

[236] U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at App. B (rev. 2021). The guidance also suggests installing a CO alarm, providing a radio for emergency updates, and ensuring adequate services such as restroom facilities and garbage disposal/collection. See also British Columbia Centre for Disease Control, Evidence Review: Home and Community Clean Air Shelters to Protect Public Health During Wildfire Events at 2, 20 (2014).
[237] U.S. EPA, COVID-19, Wildfires, and Indoor Air Quality.
[238] U.S. EPA, Schools as Cleaner Air and Cooling Centers: Tips for Facility Managers, Principals, Teachers, and Parents and Caregivers.

provided technical assistance to four communities for the development of cleaner air and cooling centers in public school facilities.[239]

California Technical Guidance for Cleaner Air Centers

Few states have issued detailed guidance for setting up and operating cleaner air centers. In California, the Air Resources Board has established technical IAQ-related requirements for recipients of its clean air center grants, and other state laws have led to the publication of additional information on setting up and operating a cleaner air center.

Sacramento Air Pollution Emergency Plan. In 2019, California legislation directed the Sacramento Metropolitan Air Quality Management District to prepare a wildfire smoke air pollution emergency plan as an informational source for local agencies and the public during a wildfire smoke air pollution emergency. Cal. AB 661; Cal. Health & Safety Code §§41090-41094. The plan published in 2022 recommends the following IAQ-related measures for setting up cleaner air centers: (1) pre-verify locations prior to smoke events, (2) evaluate HVAC systems and fresh-air intake, (3) install high-efficiency filters (MERV 13 or higher), (4) weatherize buildings, (5) acquire certified and appropriately sized portable air-cleaning units, (6) monitor IAQ and "institute guidelines that can preserve the cleanest air possible," and (7) keep doors and windows closed as feasible. The plan addresses transportation to the facility, recommending that agencies develop a transportation plan in advance, work with transportation providers to develop transportation/ride-share options, establish free public transit structures during a smoke event, and work with volunteer organizations that may be able to assist with transportation.[240]

California Department of Public Health Guidance. The Department of Public Health has incorporated cleaner air center information into its comprehensive wildfire smoke guidance for public health officials, Wildfire Smoke: Considerations for California's Public Health Officials. The guidance lists desirable cleaner air center characteristics, including public accessibility (e.g., community centers or libraries); newer construction (tighter building envelopes that reduce smoke infiltration); central air conditioning with enhanced system filtration capability (e.g., high-efficiency in-duct MERV 13 or higher filters); and, if necessary, access to or purchase/lease of portable air cleaners. The guidance recommends several steps that can be taken to reduce wildfire smoke intrusion into a cleaner air center, including reducing the amount of outdoor ventilation, providing a single building entry and sealing other doors, providing sticky mats at entries, inspecting existing filters, installing carbon filters over the air handling unit intakes, and installing temporary portable air filtration devices.[241]

As noted earlier, the Department of Public Health is preparing a model air pollution emergency plan for use by local governments, as required by recent legislation. Local plans must include "criteria, locations, and measurements of effectiveness for public respite facilities during poor air quality and other weather-related events." Cal. AB 619; Cal. Govt. Code §8593.25.

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[239] U.S. EPA, Schools as Community Cleaner Air and Cooling Centers: Tips for Facility Managers, Principals, Teachers, and Parents and Caregivers. The communities are the Bay Area Air Quality Management District (CA), Multnomah County (OR), Kittitas County (WA), and Pima County (AZ).

[240] Sacramento County Public Health, et al., Wildfire Smoke Air Pollution Emergency Plan for Sacramento at 28 (2022).

[241] Cal. Dept. of Public Health, Wildfire Smoke: Considerations for California's Public Health Officials at App. I (2022).

California Wildfire Smoke Clean Air Center Pilot Program Guidance. In connection with its cleaner air center pilot program, the California Air Resources Board developed a set of criteria that must be met by projects selected for funding. The guidelines, summarized below, do not include qualitative or quantitative indoor air performance measures, but they set forth brief technical criteria for each of the three types of filtration improvements eligible for funding.

California Wildfire Smoke Clean Air Centers for Vulnerable Populations Incentive Program: Technical Criteria for Filtration Upgrades

The California Air Resources Board published program guidelines for clean air centers receiving funding through the agency's grant program established by AB836. The guidelines include the following technical criteria for the three types of facility improvements eligible for funding.

Facility Ventilation Upgrades

- Upgrades must be performed or overseen by a Licensed Professional with expertise in HVAC equipment installation, maintenance, and performance assessment.
- A Licensed Professional (per state law) must submit a verification report of the upgraded HVAC system that includes: 1) Verification of installed air filters with a MERV rating of 13 or greater, 2) Verification of proper ventilation rates, 3) Documentation of all improvements or retrofits made in the facility, and 4) Verification that all work has been performed by or under the direction of Licensed Professionals.
- A plan for clean air center operations and logistics during wildfire and other smoke events must be prepared.

High-Efficiency Air Filter Purchase

- Purchased air filters must have a MERV rating of 13 or greater.
- A plan for clean air center operations and logistics during wildfire and other smoke events must be prepared.

Portable Air Cleaner Purchase

- Portable air cleaners must be certified by CARB for sale and use in California.
- Portable air cleaners must be equipped with a HEPA filter.
- A plan for operating portable air cleaners is required, including the logistics of device deployment during wildfires and other smoke events, the management of device inventory and maintenance, and the list of partner organizations and their roles.

The guidelines also set forth the information to be included in project applications and final project reports, including an HVAC assessment report for projects other than portable air cleaner purchases.

Source: Cal. Air Resources Bd., Wildfire Smoke Clean Air Center Grant Guidelines (rev. 2022).

Section 4: Material Assistance Policies for Filtration and Related Measures

Clear and timely information about wildfire smoke risks is essential for enabling people to reduce their exposure, but many people are not in a position to take the steps needed to create cleaner air spaces within their homes. This section describes several types of material assistance programs that could be used by states to provide air filters and related interventions, such as air conditioning and air sealing, to help reduce smoke and other air pollutant exposures at home. The programs are funded through a variety of federal and state sources and some are implemented by tribal and local agencies and non-governmental organizations.

The discussion begins by describing an Oregon program created to distribute air cleaners directly to households for use in wildfire smoke emergencies. The remainder of the section highlights state programs that are not specific to wildfire smoke but are potential sources of funding for the air filters and related equipment that would help reduce smoke exposure in future smoke emergencies. These programs are implemented in areas ranging from asthma control and healthy homes to utility assistance and energy efficiency. States can review the full range of their funding policies and programs to identify these and other opportunities for addressing wildfire smoke.

EPA's Wildfire Smoke Guide recommends that public health officials have a supply of NIOSH-approved respirators available to disseminate to the public and "consider approaches to supplying portable air cleaners."[242] Material assistance for reducing smoke exposure is needed not only for wildfires but also for prescribed burns. In 2023, the federal Wildland Fire Mitigation and Management Commission reported that it "felt strongly that actions which enable people to prepare for and live safely with smoke are not only important, but indispensable, to the increasing use of beneficial fire."[243] A 2023 article by EPA and CDC scientists noted that the planned nature of prescribed fires allows agencies to help communities take actions in advance to help reduce smoke exposure, but that "such preparedness initiatives are rarely undertaken."[244]

[242] U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 51 (rev. 2021). A recent article examining cleaner air center use among residents of a community disproportionately impacted by smoke due to socioeconomic factors found that only 4 of 15 people interviewed had a DIY or commercial air cleaner. R. Treves, et al., Wildfire Smoke Clean Air Centers: Identifying Barriers and Opportunities for Improvement from California Practitioner and Community Perspectives, Soc. & Nat. Res., 36:9, 1078-1098, 1087 (2022).

[243] Wildland Fire Mitigation and Management Commission, On Fire: The Report of the Wildland Fire Mitigation and Management Commission at 100 (Sep. 2023).

[244] J. Sacks, et al., At the Intersection: Protecting Public Health from Smoke While Addressing the U.S. Wildfire Crisis, Am. J. Respir. Crit. Care Med., Vol. 208, No. 7 at 755 (10/1/23). See also S. Hoshiko, et al., Responses to Wildfire and Prescribed Fire Smoke: A Survey of a Medically Vulnerable Adult Population in the Wildland-Urban Interface, Mariposa County, California, Int. J. Env. Res. Pub. Health 20(2), 1210 at 4 (listening sessions conducted by California agencies found that a smaller proportion of respondents reported taking protective measures for prescribed burns than for wildfires).

The 2024 National Academies report on indoor particulate matter urges action to reduce indoor PM exposure: "Given that practical mitigation is possible and has beneficial effects, it is important that such mitigation be a priority—in particular, for schools and economically-disadvantaged households, where there may be concentrations of people who are susceptible to adverse health effects and who have limited ability to ameliorate exposure."[245] The Bipartisan Infrastructure Law of 2021 and the Inflation Reduction Act of 2022 have significantly increased the availability of federal funds for activities that include reducing indoor air risks. State funding is also important for creating new programs and/or expanding existing programs to address wildfire smoke.

Although this section focuses on material assistance for homes, many states have been active in providing funding for non-residential building improvements generally and for HVAC improvements specifically. In the workplace context, a recent law in *Washington* (SB 1587) provided $10 million from the state's climate commitment account for a worker health and safety program to help "vulnerable populations in overburdened communities" by providing, among other things, air cleaners or cooling devices for workplaces or worker housing. Funding for school facilities expanded considerably during the pandemic, with states such as *California* and *New Jersey* using federal pandemic funding and state funds to support school HVAC improvements and states such as *Colorado*, *Montana*, and *Illinois* using federal pandemic funds to distribute portable air cleaners.[246] *New York's* Clean Green Schools Initiative recently announced the availability of $100 million in funding for school building decarbonization and "clean heating and cooling" projects, which may include building ventilation and filtration system capital projects. The Initiative, which is open to school districts designated as "high needs" or located in a "disadvantaged community," is funded from the state's Clean Water, Clean Air, and Green Jobs Environmental Bond Act, as well as the state Clean Energy Fund, and the Regional Greenhouse Gas Initiative.[247]

Programs Providing Residential Air Cleaners for Wildfire Smoke

Tribal and local government agencies and non-governmental organizations have played a leading role in providing community residents air cleaning devices for reducing indoor wildfire smoke exposure, often with funding support from state or federal agencies. The *Nez Perce Tribe* Air Quality Program, e.g., recently implemented a project with federal and state funding to purchase and distribute portable air cleaners to higher-risk Nez Perce Tribal households and to conduct outreach around wildfire smoke, indoor air quality, and the use of portable air cleaners.[248] Several tribes in Oregon used smoke readiness funding from the state Department of Environmental Quality (through SB 762) to purchase and

[245] NASEM, Health Risks of Indoor Exposure to Fine Particulate Matter and Practical Mitigation Solutions at 217 (2024).
[246] See ELI, State Funding for School Ventilation: A Review of Selected Policies, 2020-2022 (2023)/ See also Mt. Dept. of Public Health & Human Svcs., Air Purifiers in Schools Program (2023); Ill. Dept. of Public Health, IDPH Launches $30 Million Program to Distribute Air Purifiers in Illinois Schools (Mar. 2023); Co. Dept. of Public Health & Envt., Clean Air for Schools.
[247] NYSERDA, P-12 Schools Clean Green Schools Initiative: Program Opportunity Notice PON 4924; State of New York, $100 Million Environmental Bond Act Funding Now Available for Clean, Green Schools (1/23/24).
[248] ELI Communication with Nez Perce Tribe (July 2023). The tribe will build on this work, using a new wildfire smoke grant from EPA. In addition to continuing to provide portable air cleaners, the tribe will conduct indoor/outdoor air monitoring, undertake weatherization, and upgrade community buildings to serve as cleaner air spaces. See U.S. EPA, Announcing Anticipated Grant Awardees: Wildfire Smoke Preparedness in Community Buildings Grants.

distribute air cleaners and replacement air filters to community members.[249] The City of *Flagstaff, Arizona*, recently implemented a HEPA Filter Program that provides free air purifiers to at-risk community members to provide protection from wildfires.[250] In 2021, the *Santa Barbara (CA) Air Pollution Control District* allocated $100,000 for a Clean Air Rooms Pilot Program to provide HEPA air purifiers to county residents "in traditionally underserved areas home to many outdoor workers, who often endure wildfire smoke while working" and used a state environmental justice mapping tool to identify two communities to participate in the program.[251]

Such programs can provide valuable insights about the opportunities and practical challenges involved in distributing air cleaners and other types of material assistance. One organization, *Smokewise Ashland*, has created a how-to guide for developing an air cleaner distribution program, covering topics such as developing partnerships, designing equitable access, selecting an air cleaner, and funding the program.[252]

As described above in Section 1, *California* law now requires local governments address material assistance in their plans for wildfire smoke and other air quality emergencies. The law requires those local plans to include "a process to provide emergency provisions of respiratory protection, air purifiers," and other medical needs in connection with wildfires and other air quality events. Cal. AB 619 §1; Cal. Govt. Code §8593.25. The state's model plan must include policies and procedures addressing whether/how to stockpile and distribute protective equipment and devices. Cal. AB 619 §3; Cal. Health & Safety Code §107250.

Few states have developed and implemented programs to distribute air cleaning devices directly to residents. Oregon is a notable exception.

Oregon Health Authority's Air Filter Distribution Program

Oregon's 2021 comprehensive wildfire smoke legislation directed the Oregon Health Authority to "establish a program to increase the availability of smoke filtration devices." Or. SB 762 §15; Or. Rev. Stat. §431A.415. The following year, legislation addressing extreme heat expanded the program to include air conditioners and provided additional details on program implementation. Or. SB 1536 §7.

SB 762 defined "smoke filtration devices" to include portable air cleaners or HVAC filters. SB 1536 clarified that air filters do "not include a device that is labeled an 'air purifier' and that uses an electrostatic or ionizing process" and defined air conditioner as "a portable, stand-up air conditioner that has an energy efficiency ratio rating of eight or higher." SB 762 provided around $4.8 million to OHA for the program for the 2021-2023 biennium.[253] SB 1536 added around $5 million for the purchase and distribution of air conditioners.

[249] Other activities included the development of a smoke notification system, purchase of low-cost sensors for outdoor air monitoring, and development of education and outreach materials. Or. DEQ, SENATE BILL 762: DEQ Community Smoke Response and Preparedness Funding Report at 10-12, 16 (Aug. 2023); ELI Communication with Or. DEQ (Dec. 2023).
[250] See City of Flagstaff (AZ), Flagstaff HEPA Filter Program.
[251] Santa Barbara APCD, APCD Gives Hundreds of Free Air Purifiers to Guadalupe, Casmalia Residents (2021).
[252] Or. Prescribed Fire Council, Room Air Purifier Program: Preparing your Community for Smoke.
[253] State of Oregon, Advancing Fire Protection in Oregon: Wildfire Programs Advisory Council Annual Report at 28 (Oct. 2023).

Eligibility for Assistance. SB 762 established the grant program for "persons vulnerable to the health effects of wildfire smoke who reside in areas susceptible to wildfire smoke." SB 1535 limited distribution to individuals who (1) have been eligible for state medical assistance within the prior 12 months, (2) reside in housing that has electricity for operating the device, and (3) will provide an "attestation that the individual can safely and legally install the air conditioner or air filter in the individual's home or recreational vehicle."

In implementing the program, OHA established that to be eligible for an air filtration device, an individual could not already have an air filter and had to reside in one of seven designated counties. In addition to the medical assistance eligibility requirement, the program limited distribution of air filters and air conditioners to people at risk for health issues due to wildfire smoke, including: "People age 65 years or older; or Medically fragile children; or People with a disability or health condition that makes them vulnerable to wildfire smoke. These include diabetes, heart disease, hypertension, obesity, or a respiratory disease."[254]

Distribution of Devices. SB 1536 addressed the process of distributing the air filters and air conditioners, requiring OHA to: "(A) Acquire a supply of air conditioners and air filters; and (B) Distribute the air conditioners and air filters to eligible distribution entities that will provide the air conditioners and air filters on an emergency basis to eligible individuals…" The legislation defined eligible distribution entities broadly to include tribes, Indian health centers, coordinated care organizations, local governments, local housing authorities, community action agencies, non-profits, electric and gas utilities, and landlords with tenants who are eligible under the program. SB 1536 also directed OHA to provide technical assistance to the distribution entities to support distribution, installation, and maintenance of the devices and to make technical assistance resources available to individuals who receive the devices.

Program Implementation. OHA created a dedicated program to implement the law within the agency's Health Security Preparedness and Response Program, with a staff position funded through the legislation. The program purchased 9,700 air filtration devices, with around half distributed in each of the two years. The program also distributed thousands of air conditioners.[255]

Because OHA had limited time to set up the program, in the first year the agency distributed the air filters through an existing network of Medicaid coordinated care organizations (CCOs). OHA was able to use Medicaid system billing/diagnosis codes to identify people who would be eligible due to health conditions, and OHA and CCOs reached out directly to eligible individuals. OHA purchased devices in advance and shipped them to CCOs to deliver.[256]

In the second year, the program's distribution strategy for air filters and air conditioners was broadened beyond CCO outreach to individuals identified through the Medicaid system. OHA established working relationships with state health services agency (ODHS) programs and local community-based organizations (CBOs) that could reach individuals who might be eligible for the program but were not in the Medicaid system. The availability of self-attestation for eligibility meant that CBOs did not have to

[254] Or. Health Authority, Air Conditioner and Air Filter Deployment Program.
[255] ELI Communication with Or. Health Authority (June, Dec. 2023); Or. Dep of Human Svcs., 2023 Legislative Report: Senate Bill 762 and Senate Bill 1536 (2023).
[256] ELI Communication with Or. Health Authority (June 2023).

collect personal information from interested individuals. OHA ran a call center to screen referrals from CBOs and ODHS and enter the information into a tracking system. The program also moved to a system of delivering air filters by FedEx to the recipient's home so that people who may be medically vulnerable would not have to travel to obtain the devices. This added cost was facilitated by leveraging ODHS' existing ground transport arrangements for their emergency response programs.[257]

In addition to supplying devices, the program provided a replacement air filter with each device and offered supportive materials, such as information on replacing filters and a user-friendly walk-through of how to unbox and set up air conditioning units. OHA also worked with partners to provide installation assistance when possible.[258]

Although the two-year program funding was not sufficient to meet the full need for air filters, Oregon Health Plan members may still be able to receive air filters or air conditioners through other avenues. As described later in this section, the state applied for and received a Medicaid waiver that will allow funds to be used to pay for these devices, and CCOs may also provide such equipment as "flexible services." In a 2023 report reviewing implementation of Oregon's new wildfire programs, the state Wildfire Programs Advisory Council recommended continued funding for distributing air cleaners and broadening eligibility to include "programs that provide materials for do-it-yourself (DIY) air cleaners using box fan(s) and MERV 13 filter(s)."[259]

Healthy Homes Programs

Healthy homes programs address a range of environmental health issues, including indoor asthma triggers. In some jurisdictions, the program is combined with the state's lead poisoning prevention program.[260] Healthy homes programs offer education and in-home assessments, and in some cases also provide minor equipment or home modifications. They are thus a potential vehicle for helping people create a cleaner air space within the home.

States have used a variety of funding sources to support healthy homes programs.[261] In 2021, Oregon legislators established and funded a new program to provide healthy homes grants.[262]

Oregon Health Authority's Healthy Homes Grant Program

The Oregon Health Authority's new Healthy Homes Grant Program (HHGP) was established to "provide financial assistance to persons in low-income households to repair and rehabilitate their residences and

[257] Id. In the second year, the program provided air filters to tribes and tribal health providers, many of whom already had processes in place to facilitate distribution.
[258] Id.
[259] State of Oregon, Advancing Fire Protection In Oregon Wildfire Programs Advisory Council Annual Report at 29 (Oct. 2023).
[260] See, e.g., Ga. Dept. of Public Health, Healthy Homes and Lead Poisoning Prevention; N.H. Dept. of Health & Human Svcs., Lead Poisoning Prevention Program.
[261] Natl. Center for Healthy Housing, Strategies Toward Sustainability: More Financing Mechanisms for Healthy Homes Services (2019). In 2018, the Connecticut legislature created a Healthy Homes Fund funded by a new surcharge on home-owner's insurance policies. Most of the funds are targeted to repair crumbling foundations in a specific area of the state; the rest is available to reduce other health/safety hazards in homes throughout the state. Ct. HB 5209; Ct. Stat. §8-446.
[262] See Or. Health Authority, Healthy Homes Grant Program.

to landlords to repair and rehabilitate dwelling units inhabited by low-income households." 2021 Or. HB 2842; Or. Rev. Stat. §431A.400.[263] In September 2023, OHA adopted program rules. Or. Admin. Code §§333-090-0100—0140.

The 2021 legislation allocated $10 million for the program, and in 2022 the legislature added $5 million through SB 1536. The funds were deposited into a new Healthy Homes Repair Fund that is the exclusive source of funding for the program. In addition to implementing the grant program, HB 2842 authorizes OHA to develop methods for evaluating and preventing health hazards in housing and to make "recommendations for promoting the incorporation of healthy housing into ongoing practices and systems, including housing codes."

Eligibility for Assistance. Under the new program, OHA will make grants to eligible entities (including local government entities, nonprofits, tribes, coordinate care organizations, community action agencies and utilities), who in turn will assist households with healthy homes modifications. In line with OHA's goal to eliminate health inequities by 2030, the legislation requires that entities receiving funding serve or represent communities with high concentrations of low-income households or communities "impacted by environmental justice factors," as defined in the law. Or. Rev. Stat. §431A.400.[264] OHA rules echo these criteria and state that the agency "may set aside funding to ensure resources remain available for specific uses and for specific populations." Or. Admin. Code §§333-090-0100(5), 333-090-0110(3). The rules also allow the agency to weigh "(e)vidence that the applicant has established relationships with the community proposed to be served" when making funding decisions. Or. Admin. Code §333-090-0120(5).

Eligible Activities. The HHGP is designed to fund a broad range of repair and rehabilitation activities, including "actions" that maximize energy efficiency, extend the useful life of homes, or improve occupant health and safety. The health and safety category incorporates measures ranging from mitigating pollutants and reducing heat reflection to improving accessibility and upgrading electrical systems. One item expressly included is "[i]nstallation of a smoke filtration system, an air purification system or ventilation or reduction of pathways for air infiltration." Smoke filtration system is defined as "a residential air filtration system that meets minimum efficiency standards, as determined by the authority, for the removal of particulates and other harmful substances generated by wildfires." Or. Rev. Stat. §431A.400(1)(g), (i); Or. Admin. Code §333-090-0100(14)(c). The program web page includes poor IAQ from wildfire smoke as an example of the problems that can be addressed.[265]

The OHA rules add that activities undertaken with the grant must comply with state and local contractor licensing and permitting requirements, as well as any applicable standards for equipment purchased. Or. Admin. Code §333-090-0140.

[263] The legislation was amended in 2022 (SB 1536) and 2023 (HB 2987). The original legislation limited administrative and program delivery costs to 15% or less of the grant; the 2023 legislation changed this to allow OHA more flexibility in establishing the percentage. The rules adopted by OHA set a 20% cap. Or. Admin. Code §333-090-0110(5).

[264] "'Environmental justice factor' means a circumstance or condition that impacts a community's ability to achieve a balance of health, economic or environmental benefits and burdens or that impacts a community's ability to participate in public processes." Or. Rev. Stat. §431A.400

[265] Or. Health Authority, Healthy Homes Grant Program.

Program Implementation. The legislation established an Advisory Committee to aid in initial development of the new program, and OHA also created a separate advisory group to consult specifically on the rulemaking process. The agency will be setting up another advisory group to help implement the program on an ongoing basis and to incorporate input from individuals with practical experience working with the communities served by the program.[266]

OHA hired two full-time staff to develop and run the HHGP.[267] Given the broad array of eligible activities and organizations, the program plans to provide multiple rounds of funding that address different priorities, with the first round expected to be announced in winter 2023-2024 and funding distributed in early summer 2024.[268]

Asthma Control Programs

State public health agencies commonly implement programs to help people control and manage their asthma. Many state asthma programs are funded by the Centers for Disease Control and Prevention, whose EXHALE program advances a range of strategies, including "[e]nvironmental policies or best practices to reduce indoor and outdoor asthma triggers."[269] The EPA Indoor Environments Division facilitates the Asthma Community Network resource platform, which provides information on a range of topics including financing in-home asthma care.[270] The National Center for Healthy Homes has collaborated with EPA to develop a technical assistance platform to support "large-scale, evidence-based, sustainable asthma home visiting programs."[271]

Because indoor exposure to particulate matter can worsen asthma symptoms, state asthma programs are a potential vehicle for conducting home visits and providing material assistance for reducing exposure to wildfire smoke. *Montana* is an example of a state whose Asthma Control Program helps residents reduce indoor asthma triggers such as particulate matter. The Montana Asthma Home Visiting Program (MAP), a state-funded program operated by local public health contractors, provides in-home and/or virtual home visits in all 56 counties of the state. Participants receive a home environmental assessment to identify asthma triggers and may also receive a HEPA air cleaner and other equipment.[272]

States have used a variety of funding sources to support their work reducing indoor asthma triggers. Some have received approval for using Medicaid funds to pay for interventions that reduce indoors triggers in the homes of people with asthma.

[266] ELI Communication with Or. Health Authority (Dec. 2023).
[267] Id.
[268] Id.; Or. Health Authority, Healthy Homes Grant Program.
[269] U.S. CDC, EXHALE: Strategies to Help People with Asthma Breath Easier. See also U.S. CDC, Guide for State Health Agencies in the Development of Asthma Programs.
[270] Asthma Community Network, Financing In-Home Asthma Care.
[271] Natl. Center for Healthy Housing, Building Systems to Sustain Home-Based Asthma Services.
[272] ELI Communication with Mt. Dept. of Public Health & Human Svcs. (July 2023).

State Medicaid Programs

As noted in a recent report by the Green and Healthy Homes Initiative, although healthy homes interventions historically have not been reimbursable under state Medicaid programs, "in recent years the healthcare system has begun to acknowledge the significance of housing and other nonmedical determinants of health outcomes, especially for underserved and vulnerable communities."[273] The Medicaid program, a federal-state partnership that provides health insurance for low-income and disabled individuals, currently offers states some flexibility in structuring their programs to cover preventive services such as evidence-based interventions for reducing asthma triggers in homes.[274]

One way to use Medicaid funds to cover home interventions such as air filters and air conditioners is to seek a waiver from the federal Medicaid program that allows states to "cover more people, cover more benefits, or deliver care in a different way" than traditional health care services.[275] Waivers can be requested under Section 1115 of the Social Security Act, which authorizes the federal government to approve experimental, pilot, or demonstration projects that are likely to promote the objectives of the Medicaid program. 42 U.S.C. §1315. Another avenue is to develop a Health Services Initiative (HSI) through the Children's Health Insurance Program (CHIP) program. 42 U.S. Code §1397ee; 42 C.F.R. §457.10. In 2021, the federal Centers for Medicare and Medicaid Services (CMS) issued a policy that described various opportunities for addressing housing and other social determinants of health in the Medicaid and CHIP programs.[276]

Examples of states that recently established policies to cover air filters and air conditioners through their Medicaid and medical assistance programs include Wisconsin, Massachusetts, Oregon, and Minnesota.

- The *Wisconsin* Department of Health Services received federal approval under the CHIP program to implement a Health Services Initiative, the Asthma-Safe Homes Program. The program, created in 2021, provides services in Wisconsin counties with high asthma burdens to Medicaid-eligible children and pregnant individuals with uncontrolled asthma. In addition to asthma education, the program provides up to $1,000 worth of free products that can help reduce asthma triggers, including home air cleaners and air conditioners. The program also provides up to $5,000 in environmental home repair services, which may include window and door sealing, along with items such as mold cleanup and pest control.[277]

- *Massachusetts* has received a Section 1115 waiver that allows the Commonwealth's Medicaid and CHIP programs to cover health-related social needs including "medically necessary air conditioners,

[273] Green & Healthy Homes Initiative, Reimbursement Strategies for Healthy Homes Services: Considerations for State Medicaid Offices (2022) (providing advice/guidance on developing waiver programs to advance healthy housing).
[274] See generally, Natl. Center for Healthy Housing, Pathways to Reimbursement: Understanding and Expanding Medicaid Services in Your State.
[275] Or. Health Authority, 2022-2027 Medicaid 1115 Demonstration Waiver.
[276] Center for Medicare and Medicaid Services (CMS), Social Determinants of Health (SDOH) State Health Official (SHO) Letter (2021). See also CMS, All-State Medicaid and CHIP Call (12/6/22) (noting that "medically necessary home environment modifications….including air conditioners, heaters, air filtration devices, and generators" were potentially eligible services.) See generally Green & Healthy Homes Initiative, Reimbursement Strategies for Healthy Homes Services: Considerations for State Medicaid Offices (2022).
[277] Wisc. Dept. of Health Svcs., Asthma-Safe Homes Program.

humidifiers, air filtration devices and asthma remediation," as well as repairing or improving ventilation systems.[278]

- The *Oregon* Health Plan's Section 1115 demonstration program, approved for the October 2022-September 2023 period, will address Oregon Health Plan (OHP) participants "health-related social needs," including "devices that maintain healthy temperatures and clean air, including air conditioners, heaters, air filters, and humidifiers."[279] As of late 2023, the state was determining eligibility requirements for these benefits and was planning to first cover OHP members in "life transitions," including people "who experience weather-related emergencies."[280] The benefits are expected to be available starting in March 2024.[281] Another avenue for OHP participants to receive items such as air conditioners or air filters is through "flexible services" offered by coordinated care organizations, though CCOs are not required to provide these devices as flexible services.[282]

- *Minnesota* also provides air filters for asthma care. Legislation enacted in 2021 specifically authorized state medical assistance coverage for "enhanced asthma care services and related products to be provided in the children's homes for children with poorly controlled asthma." Covered products listed in the law include furnace filters and HEPA single-room air cleaners and filters. Mn. Stat. §256B.0625 sub. 31, 67.[283]

Utility Assistance Programs

Extreme heat is responsible for more deaths in the U.S. than any other weather-related event, and the impacts fall disproportionately on lower-income households and communities of color.[284] When wildfire smoke episodes occur during periods of high heat, it can be dangerous for people to stay inside with windows and doors closed if their homes cannot otherwise provide adequate cooling.

The federal Low-Income Home Energy Assistance Program (LIHEAP) provides funding annually to all 50 states, the District of Columbia, several U.S. territories, and over 150 tribes and tribal organizations, which in turn distribute the funds to eligible low-income households. LIHEAP funds may be used for space heating or space cooling – e.g., to subsidize utility costs for running air conditioners and to purchase or repair an air conditioning unit. The LIHEAP program issued a memorandum in 2022 outlining ways LIHEAP programs can be adjusted to address extreme heat.[285]

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[278] CMS, MassHealth Extension Approval Letter at 117-188 (Sept. 2022) (extending waiver authorities); see also Massachusetts Section 1115 Demonstration Project Extension Application (Att. F at 7).
[279] Or. Health Authority, 2022 2027 Waiver FAQ at 4-6 (rev. Dec. 2023).
[280] Or. Health Authority, 2022-2027 Medicaid 1115 Demonstration Waiver.
[281] Or. Health Authority, 2022 2027 Waiver FAQ at 5 (rev. Dec. 2023).
[282] Id; Or. Health Authority, Flexible Services Info for OHP Members in Coordinated Care Organizations (Apr. 2022).
[283] See also Mn. Dept. of Human Svcs., Minnesota Health Care Programs (MHCP) Asthma Home Evaluations and Allergen-Reducing Products for Children FAQs; Mn. Dept. of Human Svcs., Allergen-Reducing Products for Children.
[284] See, e.g., U.S. EPA, Climate Change and Social Vulnerability in the United States at 35 (2021) ("minorities and those with low income are more likely than non-minorities and those with higher income to currently live in areas with the highest projected increases in temperature mortality from climate-driven changes in extreme temperatures").
[285] U.S. Dept. of Health & Human Svcs., LIHEAP IM-2022-06 Heat Stress Flexibilities and Resources FY2022.

As states plan for extreme heat and wildfire events, they can consider expanding the portion of their LIHEAP funding dedicated to cooling assistance. States have considerable discretion in using their LIHEAP funds, and not all state programs provide cooling assistance as a regular benefit.[286] In light of rising average temperatures and more intense heat waves, as well as larger and more frequent wildfires, increased overall funding for energy assistance programs may also be needed to enable states to provide heating assistance *and* respond to the greater need for cooling.

Washington state recently added cooling benefits and took the unusual approach of incorporating the distribution of *portable air cleaners* into its LIHEAP program at the same time. Following extreme heat events in 2021, the state amended its LIHEAP state plan to add cooling as an emergency service and has continued to incorporate this element in its plans. Those eligible for LIHEAP can receive funds to cover the cost of the electricity used to cool their homes and can also receive an air conditioner (for renters, a portable air conditioner could be provided).[287] Because Washington's extreme heat in 2021 was accompanied by severe wildfires, the program added an air cleaner component when it amended its LIHEAP plan to add cooling benefits, and the state has continued this service. Under the plan, if the Governor declares a state of emergency for wildfire, the program can provide a portable air cleaner to LIHEAP-eligible residents of counties covered by the declaration.[288] Thus far the program has provided several air cleaners; its limited reach may be due in part to the emergency declaration prerequisite.[289] The addition of these services in Washington state was facilitated by additional LIHEAP funding available during the pandemic.

In 2023, the Washington legislature appropriated $35 million for providing energy assistance services similar to the LIHEAP program to people living in a "community that experiences high environmental health disparities" but whose income is higher than LIHEAP program limits. Wash. SB 5187 §128(34).

Weatherization Programs

There are a multitude of programs at all levels of government that support energy-efficiency retrofits of existing homes, a core strategy for mitigating climate change and reducing utility costs for low-income households. Energy efficiency and health are compatible goals for retrofit projects, particularly when indoor air quality measures are expressly incorporated into the program framework.[290]

State policies and programs that provide financial incentives for home energy retrofits or upgrades could prioritize IAQ generally as well as incorporate specific IAQ standards and requirements. In *California*, for

[286] See U.S. Dept. of Health & Human Svcs., Benefit Levels for Heating, Cooling and Crisis.
[287] Wash. Dept. of Commerce, Washington State Low Income Home Energy Assistance Program (LIHEAP); ELI Communication with Wash. Dept. of Commerce (July 2023). According to Commerce officials, a declaration of heat emergency is not required. The 2024 draft plan includes these cooling services. Wash. Dept. of Commerce, 2024 Draft LIHEAP State Plan.
[288] Wash. Dept. of Commerce, 2024 Draft LIHEAP State Plan at 15; Wash. Dept. of Commerce, Washington State Low Income Home Energy Assistance Program (LIHEAP).
[289] Wash. Dept. of Commerce, 2024 Draft LIHEAP State Plan; ELI Communication with Wash. Dept. of Commerce (July 2023). According to Commerce officials, the agency is considering alternative approaches that would enable the LIHEAP program to provide the devices before the emergency is declared.
[290] See generally U.S. EPA, Energy Savings Plus Health: Indoor Air Quality Guidelines; U.S. EPA, Protecting IAQ During School Energy Efficiency Retrofit Projects with Energy Savings Plus Health Guidelines.

example, the GoGreen Home Energy Financing Program includes air filter upgrades as an eligible activity, provided that the upgrade uses MERV 13 filters and installs an ECM fan motor and a filter sensor or alarm. The program may also provide funding for air cleaners. 4 Cal. Admin. Code §10091.10(j). Programs such as *New Mexico's* Community Energy Efficiency Development Block Grant program fund energy efficiency improvements in residential buildings in underserved communities and define energy efficiency broadly to include "health and safety measures that use efficient equipment or devices to improve indoor air or drinking water quality." N.M. Stat. §62-17A-2.

Weatherization programs are a key resource for improving energy efficiency in low-income households. The largest source of funding for state weatherization programs is the federal Weatherization Assistance Program (WAP) run by the U.S. Department of Energy (DOE). The program provides grants to "increase the energy efficiency of dwellings owned or occupied by low-income persons…reduce their total residential expenditures, and improve their health and safety, especially low-income persons who are particularly vulnerable such as the elderly, persons with disabilities, families with children, high residential energy users, and households with high energy burden." 10 C.F.R. §440.1; 42 U.S.C. §6861. WAP funds are provided to states, the District of Columbia, U.S. territories, and tribal governments ("grantees"), which then contract with local governments, community action agencies, and nonprofit organizations to implement weatherization projects. The Bipartisan Infrastructure Law of 2021 added significant additional funds to the program.[291]

Federal weatherization funds can be used not only for reducing infiltration of outdoor air into homes, but also for providing certain health and safety improvements.[292] Program guidance establishes whether specific health and safety actions are required, allowed, or prohibited uses of program funds.[293] For example, projects are required to provide ventilation that complies with ASHRAE 62.2-2016, with certain exceptions.[294] The 2016 version of ASHRAE 62.2 requires MERV 8 filters "upstream of cooling coils or other wetted surfaces through which air is supplied to an occupiable space" for buildings that are not located in a $PM_{2.5}$ nonattainment area. ASHRAE 62.2-2016, §§5.8, 6.2.1.2.

However, WAP grantees can opt to require higher-efficiency filtration than is required. The WAP health and safety guidance states: "Grantees may voluntarily elect to adopt the most recent version of ASHRAE 62.2 as soon as they are prepared to implement the Standard. They must include notification of this in their H&S Plan." This is significant because the 2022 version of ASHRAE 62.2 increased the minimum filtration requirement to MERV 11 for all "mechanical systems that supply air to the dwelling unit through ductwork exceeding 10 ft (3 m) in length and through a thermal conditioning component." ASHRAE 62.2-2022 §6.7 (add. m).

[291] See U.S. Dept. of Energy, Weatherization Program Notice BIL 22-1 (2022).
[292] See U.S. Dept. of Energy, Weatherization Program Notice 22-7: Weatherization Health and Safety; U.S. Dept. of Energy, Weatherization Health & Safety (indoor air quality is an allowable energy-related health and safety activity).
[293] U.S. Dept. of Energy, Weatherization Program Notice 22-7: Weatherization Health and Safety; U.S. Dept. of Energy, WPN 22-7 Table of Issues.
[294] US. Dept. of Energy, WPN 22-7 Table of Issues at 14.

In addition to improving filtration, states can provide air conditioning as an eligible health and safety measure.[295] The guidance also allows grantees to address "additional [health and safety] hazards specific to their program that are not included" in the guidance.[296] Thus, states can develop their WAP-funded programs in ways that will improve IAQ and equip homes for wildfire smoke and other emergencies.

States can also establish separate funding for health-related items that are not otherwise eligible WAP expenditures. *Washington* is an example of a state that established a Weatherization Plus Health program to cover certain IAQ improvements and other health-related measures.[297] Rev. Code Wash. §70A.35.010 et seq. A 2023 *Maryland* law directs the state Department of Housing and Community Development to "identify additional funding sources to support a possible expansion of programs that support a whole-home approach" to energy efficiency and conservation by addressing health and safety upgrades, weatherization, and "other general maintenance for low-income housing." Md. HB 169; Md. Public Util. Code §7–211.1(g). The Maryland law lists sources of funding to be considered, including several existing federal and state programs, as well as state appropriations. Md. Public Util. Code §7–211.1(g). The law also establishes a Task Force consisting of broad governmental and non-governmental representation to identify and help coordinate resources to "more effectively deliver green and healthy housing for low-income households."

The federal LIHEAP program is also a source of funding for weatherization. State may allocate up to 15 percent of their basic LIHEAP grant allocation for low-cost residential weatherization or other energy-related repairs and up to 25 percent if they meet certain conditions and obtain a federal waiver.[298] In FY2022, 47 state grantees provided funds for these services.[299] In *Colorado*, the state's energy assistance law was amended in 2021 to require, among other things, that when LIHEAP funds are used to install energy retrofits, the state energy office and the funded organization "shall prioritize maximizing customer savings, reducing emissions, and improving indoor air quality." Co. Rev. Stat. §40-8.7-109**.**

Home Repair Programs

States administer a variety of home repair and renovation programs that could potentially be a source of funding to provide enhanced filtration, cooling, or air sealing to low-income households.[300] These programs are supported by federal and state funding sources.

The largest federal program supporting housing rehabilitation is the Community Development Block Grant (CDBG) program, implemented by the Department of Housing and Urban Development (HUD).[301] 42 U.S.C. §§5301 et seq.; 24 C.F.R. Pt. 570. HUD awards CDBG funds to entitlement communities (large localities), states (for use in non-entitlement communities), and tribes, which in turn distribute the funds

[295] Id. at 14, 3 (allowing grantees to "[r]eplace, repair, or install primary air conditioning in homes where current occupants meet Grantee's definition of 'at-risk'").
[296] U.S. Dept. of Energy, Weatherization Program Notice 22-7: Weatherization Health and Safety at 5.
[297] See Wash. Dept. of Commerce, Weatherization Plus Health and Weatherization Plus Health 2022 Report (2022).
[298] LIHEAP Clearinghouse, Weatherization Overview. In most states, the same agency that administers federal WAP funds also administers LIHEAP weatherization funds.
[299] U.S. Dept. of Health & Human Svcs, LIHEAP Fact Sheet
[300] See generally Natl. Center for Healthy Housing, Establishing and Running a Local Home Repair Program (2022).
[301] Federal agencies also administer a variety of loan programs for homeowners. See, e.g., U.S. HUD, 203(k) Rehabilitation Mortgage Insurance; U.S. Dept. of Agric., Single Family Housing Repair Loans and Grants.

to housing and economic development projects serving low- and moderate-income communities. 42 U.S.C. §5303. The improvement of owner-occupied housing is one of the most common areas of CDBG activity. Grantees can provide "grants, loans, loan guarantees, interest subsidies, or other forms of assistance to homeowners for the purpose of repairs, rehabilitation, or reconstruction" and can provide similar assistance for the rehabilitation of rental housing.[302] Grantees have "flexibility under the CDBG Program to design repair and rehabilitation programs that meet the needs of their residents" and thus could set up a program with CDBG funding to support emergency repairs, weatherization, and other activities that might include upgrades to ventilation and filtration systems in low-income households.[303] Priorities for distributing funds are incorporated into CDBG planning documents, which must be developed with citizen participation.[304]

Other federal home repair programs that may be available to support ventilation, filtration, and cooling measures are HUD's HOME Investment Partnership Program and Indian Housing Block Grant Program and the U.S. Department of Agriculture's Section 504 Home Repair Program for rural communities.[305]

Some states have established their own financial assistance programs for residential rehabilitation or repair.

- One example of a loan program is *Minnesota's* Rehabilitation Loan Program and Emergency & Accessibility Loan Program, which "assist[s] low-income homeowners in financing home improvements that directly affect the safety, habitability, energy efficiency or accessibility of their homes." Loans can be issued up to $37,500 for a maximum term of 10 or 15 years and are forgiven if the recipient does not sell, transfer title, or cease to occupy the property during the loan term. The state housing agency also offers the Fix Up Loan program, which provides loans from $2,000 to $75,000 that "can finance most home improvement projects," though individual lenders determine project eligibility. The loans provide "affordable, fixed interest rates and longer repayment terms."[306]

- In 2023, legislators in *Washington* established the Low-Income Home Rehabilitation Grant Program to support repairs and improvements that address health, safety, and durability issues. Grants up to $50,000 will be available to low-income homeowners living in rural areas, with priority given to homeowners who are senior citizens, persons with disabilities, families with children five years old or younger, and veterans. Wash. HB 1250 §3. The new program replaces a similar program that provided loans rather than grants, and the legislature directed the agency to forgive outstanding balances on loans issued through the earlier program. Wash. HB 1250 §§2, 5. A Commerce report noted community concerns with the loan program, including reluctance to burden low-income clients with debt and the availability of other loans with more favorable terms.[307] The state

[302] HUD Exchange, Basically CDBG: Housing and Other Real Property Activities at 4-2, 4-4 (2012).
[303] Id. at 4-1.
[304] Documents that must be submitted to HUD include an Annual Action Plan and a three- to five-year Consolidated Plan. See 24 C.F.R. §570.302, 24 C.F.R. Pt. 91.
[305] See HUD, HOME Investment Partnerships Program; HUD, Indian Housing Block Grant Program; U.S. Dept. of Agric., Single Family Housing Repair Loans and Grants.
[306] Minnesota Housing, Home Improvement Programs.
[307] Wash. Dept. of Commerce, Weatherization Plus Health 2022 report at (2022).

Department of Commerce issued proposed rules for the grant program and plans to complete the rulemaking process in March 2024.[308]

- A 2023 Colorado law used the mechanism of special improvement districts to promote resiliency improvements in buildings. A 2010 state law created the Colorado New Energy Improvement District to "help provide the special benefits of new energy improvements to owners of eligible real property who voluntarily join the district by establishing, developing, financing, and administering a new energy improvement program through which the district can provide assistance to such owners in completing new energy improvements." Co. Rev. Stat. §32-20-105(1). In 2023, the legislature expanded the scope of this district by adding "resiliency improvements" as eligible activities and defining such improvements to include indoor air quality, as well as the ability to resist fires, mitigate the effects of extreme temperature, and mitigate "any other environmental hazard identified by the Colorado department of public health and environment." Co. H.B. 23-1005. The legislation directed the district to develop guidelines that detail the requirements for an activity to qualify as a resiliency improvement.

[308] Wash. Dept. of Commerce, Commerce Files Draft Rules. See also Wash. Dept. of Commerce, Home Rehabilitation Loan Program for Rural Low-Income Households.

Section 5: Regulatory Requirements for Air Filtration and Related Measures

In addition to providing information and material assistance, states can establish regulatory requirements that reduce wildfire smoke risks and create healthier and more resilient indoor environments. The focus on this section is on requirements for enhanced air filtration, which can provide protection from smoke and from other pollutants and infectious aerosols. Selected policies governing indoor temperature control are noted as well.

The policies highlighted here fall within several important areas of state authority, including building construction and renovation, protection of occupational safety and health, and maintenance of rental housing, school facilities, and child care facilities. Although this section only discusses policies at the state level, tribes and local governments also implement policies in some of these areas.

Among the notable policies described below are building codes in California and Washington that now require high-efficiency filtration in new construction and renovation and can serve as models for building codes in other jurisdictions. Another recent development is the establishment of workplace rules for wildfire smoke. California, Oregon, and Washington have adopted such rules, though they include potentially broad exemptions for buildings. A small number of states have established filtration requirements for existing schools, and many states have child care licensing regulations that address maximum indoor temperatures.

Building Codes and Other Construction Standards

Building codes are the central policymaking tool for establishing design and construction standards. A majority of states have adopted a mandatory statewide building code that sets minimum requirements throughout the state for at least some types of new residential and/or commercial construction and renovation. These state building codes are generally enforced at the local level, and state law may authorize localities to amend the state code; typically, local amendments must be at least as stringent as the state requirements. States may also have other laws and regulations that establish construction standards for certain types of buildings or that set requirements for addressing specific issues in new construction and renovation projects.

One significant state policy gap is the absence of requirements for high-efficiency filtration in most state building codes and other laws governing building construction.

Model Building Codes and Standards

Jurisdictions typically base their building codes on model codes and standards that have been established at the national level.

ASHRAE Standard 62. A widely referenced ventilation standard in the U.S. is ASHRAE Standard 62, a national industry consensus standard of practice intended to be adopted in regulations governing

new buildings and additions/changes to existing buildings. ASHRAE 62.1-2022 applies to schools and other commercial buildings, including larger multi-family residential occupancies, while ASHRAE 62.2-2022 applies to single family homes and smaller multi-family buildings.[309]

Both of these standards require the use of filters in HVAC systems. As noted earlier, ASHRAE 62.2 was modified in 2022 to increase the minimum filtration efficiency from MERV 6 to MERV 11. ASHRAE 62.2, §6.7 (add. m). In contrast, ASHRAE 62.1 currently requires only MERV 8 or higher filters, unless the building is located in a PM nonattainment area. ASHRAE 62.1 §§5.5, 6.1.4.2.

ASHRAE 62.2 (§8) requires buildings to prepare and implement an operation and maintenance manual with detailed instructions for maintaining the ventilation system and filters. The standard describes 31 inspection and maintenance tasks, including filter maintenance and replacement, that must be included in the manual. A separate standard, ASHRAE 180-2018, Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems, applies to both new and existing HVAC systems and includes over 300 inspection and maintenance items.

Model International Codes. Most state building codes are based on comprehensive model codes published by the International Code Council (ICC) that establish minimum standards for protecting public health and safety. The International Residential Code (IRC), which covers one- and two-family dwellings and townhouses with three or fewer stories, does not include a requirement for filtration of outdoor air, nor does it establish a minimum efficiency standard for filtration that is provided.

The International Mechanical Code (IMC), which governs commercial and larger multi-unit residential dwellings, mandates that heating and air-conditioning systems be provided with "approved filters" that are installed such that all return air, outdoor air, and makeup air is filtered upstream from any heat exchanger or coil. 2021 IMC §605.1. The IMC does not, however, establish a minimum required filter efficiency. The IMC states that owners are responsible for maintenance of mechanical systems and requires existing and new systems to be "maintained in proper operating condition in accordance with the original design and in a safe and sanitary condition..." 2021 IMC §605.1. The IMC does not incorporate the ASHRAE 62.1 maintenance provisions; however, it provides that inspections "for maintenance of HVAC systems shall be performed in accordance with ASHRAE/ACCA/ANSI Standard 180." 2021 IMC §102.3.

Green Building Criteria. Green building is characterized by the integrated consideration of a wide range of environmental and health features that go beyond minimum building code requirements. Green building policies are thus a potential vehicle for advancing best practices for improving filtration and indoor air quality. State green building policies frequently incorporate third-party criteria, which may include filtration and other items as required measures or as optional measures that earn points toward satisfying the green building criteria.[310]

[309] ANSI/ASHRAE 62.1-2022, Ventilation and Acceptable Indoor Air Quality; ASHRAE 62.2-2022, Ventilation and Acceptable Indoor Air Quality in Residential Buildings. References in this section are to the current (2022) versions of the standards unless otherwise noted.

[310] See, e.g., U.S. Green Building Council, LEED Rating Systems; Intl. Code Council & ASHRAE, 2021 International Green Construction Code; Enterprise Community Partners, Green Communities Criteria and Certification (2020); Collaborative for High Performance School, U.S. CHPS 2.0 (2020). In addition, EPA has developed voluntary Indoor airPLUS

State Policies Requiring High-Efficiency Filtration in New Construction

State building codes typically follow the lead of the model ICC codes and/or ASHRAE 62, and thus most existing codes do not require high-efficiency filtration. This may change in the coming years with the recent establishment of a MERV 11 requirement in ASHRAE 62.2-2022 and the potential for ASHRAE 62.1 and the ICC codes to be revised to strengthen filtration efficiency standards. In the meantime, states and other jurisdictions can take the initiative to improve the indoor air quality and resiliency of the building stock by revising their buildings codes to incorporate a high-efficiency filtration requirement.

Two states – California and Washington – have taken this important step in recent years.[311]

- In 2019, *California* adopted a statewide minimum requirement of MERV 13 filtration for mechanical ventilation and space conditioning systems in non-residential and residential new construction, additions, and alterations. 24 Ca. Code Regs. Pt 6, §§150.0(m)(12), (o); 120.1(b). The California Energy Commission developed the new MERV 13 standard "to ensure that filtration requirements were set at a level appropriate for our current understanding of human indoor air quality needs and the effects of particulate pollutants on human health," recognizing that "filters meeting current MERV 6 and 8 requirements are only moderately effective at filtering out airborne particulates (PM_{10}) and are unable to capture or filter out fine particulates ($PM_{2.5}$)."[312] The Air Resources Board commented that adopting the requirement throughout the state was important to "provide equal protection to all areas and population groups of concern."[313] The code also requires that manual control switches for whole-dwelling unit ventilation systems in multi-family buildings include a label indicating: "This switch controls the indoor air quality ventilation for the home. Leave switch in the 'on' position at all times unless the outdoor air quality is very poor." 24 Ca. Code Regs. Pt 6, §160.2(b)2A(ix).

- *Washington* updated its state-wide version of the International Mechanical Code to add a minimum MERV 13 filtration requirement, effective March 15, 2024.[314] The state building code now requires a minimum filter efficiency of MERV 13 (or higher) for ducted air handlers and ventilation systems over 500 cfm serving occupiable spaces in most commercial, educational, and residential occupancies subject to the code. Wash. Admin. Code §51-52-0605.[315] The code does not cover detached one-

specifications for residential construction; the agency is developing a new version of the program specifications that would establish two labeling tiers; the most recent proposal would require MERV 11 HVAC filters in the regular certification tier and MERV 13 filters in the gold tier. See U.S. EPA, Indoor airPLUS.

[311] In addition, the U.S. General Services Administration (GSA), which designs, constructs, and operates federal civilian buildings, has incorporated MERV 13 requirements into the mandatory facilities standards for construction, repair, and alterations of GSA buildings. See GSA, P100: Facilities Standards for the Public Buildings Service at 167 (Oct. 2021 w/ 2022 Addendum).

[312] Cal. Energy Commission, 2019 Energy Code Initial Statement of Reasons at 37-38, 135 (Jan. 18, 2018).

[313] Cal. Air Resources Bd., Air Resources Board Staff Comments on Proposed 2019 Residential Standards at 2 (6/26/17).

[314] Wash. State Building Code Council, State Codes, Regulations & Guidelines.

[315] For ducted air handlers and ventilation systems 500 cfm or less and/or which serve occupiable spaces in the other building occupancy types – Groups F (factory), H (high-hazard), S (storage), and U (utility and miscellaneous) – MERV 8 is required. MERV 8 is also required for recirculated air at fan-powered variable air volume terminal units with hydronic heating coils or electric resistance heating elements. For exhaust or relief air upstream of a heat exchanger or coil, a MERV 6 filter is required. MERV 4 is required for unducted air handlers and fan coil units. Wash. Admin. Code §51-52-0605.

and two-family dwellings and townhouses up to three stories high. Those dwellings must comply with Washington's version of the 2021 International Residential Code, which was not amended to require high-efficiency filtration. Under the residential code, dwelling units over 500 square feet must be equipped with local exhaust and whole house ventilation systems, and where outdoor air is provided by supply fan systems, the outdoor air must be filtered with an efficiency of MERV 8 or higher. Wash. Admin. Code §§51-51-0303, 51-51-1505.

In addition to building codes of general application, many states have policies governing the design and construction of publicly funded buildings such as schools and affordable housing. These policies – which often establish green building or high performance criteria – can be revised to strengthen filtration efficiency requirements.[316] *Alaska* has developed design and construction standards for schools that incorporate "baseline" measures considered to be "accepted practice" by the state education agency, and MERV 13 filtration is listed as a baseline measure for the Ventilation Distribution Systems and High Performance Buildings categories.[317] As noted above in Section 1, *Colorado's* new climate roadmap commits the state to reviewing its existing green building program for state-funded projects to identify opportunities for improving building resilience standards.[318]

Occupational Safety and Health Rules

A majority of states have laws and regulations that address occupational safety and health, and those policies can be an important avenue for reducing wildfire smoke exposure in workplaces.

The federal Occupational Safety and Health Administration (OSHA) implements federal regulations governing worker safety in most private workplaces throughout the country. 29 U.S. Code chap. 15; 29 Code Fed. Regs. pt. 1910. States may apply to OSHA for approval to implement the federal requirements in lieu of the federal agency; to receive this approval, the "state plan" must cover state and local government workplaces, including schools.[319] A total of 27 states (along with Puerto Rico and the Virgin Islands) have received federal approval of their state plans governing public workplaces; 21 of those state plans also cover private workplaces.[320] Some states that do not have approval to implement federal OSHA standards (and thus remain subject to federal enforcement of OSHA requirements in private workplaces) nonetheless have adopted their own occupational safety and health rules and requirements.[321]

States with approved plans must incorporate standards that are at least as stringent as those contained in federal OSHA law and regulations, and under federal law states may include provisions that are more stringent, including in areas not covered by federal law and regulations. 29 U.S.C. §667. This discretion to go farther is significant because the contaminant limits and ventilation requirements in federal OSHA

[316] In the area of affordable housing development, e.g., many states include green/healthy building criteria in their Qualified Application Plans implementing the federal Low Income Housing Tax Credit program. See BlueGreen Alliance Foundation, Healthy Building Practices In Qualified Allocation Plans (2020).
[317] Alaska Dept. of Early Educ. & Devt., Alaska School Design and Construction Standards at 61-62, 134 (2022). For examples of state policies requiring green school construction, see ELI, Healthy, High Performance School Construction.
[318] State of Colorado, Colorado Climate Preparedness Roadmap at 59 (Dec. 2023). See also Co. Rev. Stat. §24-38.8-103.
[319] U.S. Occup. Safety and Health Admin. (OSHA), Frequently Asked Questions
[320] U.S. OSHA, State Plans.
[321] See, e.g., Mt. Admin. Code §24.30.102; 43 Pa. Stat. §25-2; Wis. Admin. Code §SPS 332.15. 144.

rules address the exposures of workers in industrial settings, rather than the typical exposures in offices, schools, and other non-industrial workplaces. Most state occupational safety and health agencies have authority under their own state laws to strengthen the ventilation and filtration provisions in their workplace rules beyond what is included in federal OSHA rules.[322] During the pandemic, a few states used this authority to adopt emergency COVID rules that included ventilation and filtration measures.[323]

Over the past few years, Oregon, California, and Washington adopted rules to protect workers from wildfire smoke. In Oregon and California, indoor workplaces are exempt from the rule if they provide filtration through a mechanical ventilation system; Washington's rule exempts indoor workplaces regardless of whether they provide filtration. The rules establish similar types of measures to address wildfire smoke exposure, though the specific requirements vary. Future workplace rules can build on these examples and include stronger filtration requirements for reducing indoor wildfire smoke exposure.

California Wildfire Smoke Regulation for Workplaces

Cal/OSHA adopted its workplace wildfire smoke regulation in 2021. 8 Cal. Code Regs. §5141.1. The regulation defines wildfire smoke as "[e]missions from fires in wildlands…or in adjacent developed areas" and applies when the current AQI for $PM_{2.5}$ is 151 or greater (AQI "unhealthy" category or worse) and "the employer should reasonably anticipate that employees may be exposed to wildfire smoke." The regulation does not apply if employees are exposed for one hour or less during a shift.

The wildfire smoke regulation exempts enclosed buildings and structures "in which the air is filtered by a mechanical ventilation system and the employer ensures that windows, doors, bays, and other openings are kept closed, except when it is necessary to open doors to enter or exit." A similar exemption is given for enclosed vehicles in which the air is filtered by a cabin air filter. Thus, many indoor workplaces are not covered by the regulation.

For workplaces that are not exempted, employers must take steps to control exposure. For example, employers must use engineering controls to reduce employee $PM_{2.5}$ exposure to less than a current AQI of 151 "whenever feasible." Examples of such controls include "providing enclosed buildings, structures, or vehicles where the air is filtered." If engineering controls are not sufficient to reduce $PM_{2.5}$ levels, "the employer shall reduce employee exposures to the extent feasible." According to the regulation, whenever engineering controls are not feasible or sufficient, an employer must implement practicable administrative controls such as relocating work, changing work schedules, or providing additional rest periods.

The regulation does not include a minimum filtration efficiency standard, though Cal/OSHA has created guidance for employers with advice on how to use the HVAC system to protect building occupants from wildfire smoke. The guidance, Protecting Workers Exposed to Smoke from Wildfires, notes that the regulation exempts buildings with HVAC filtration, but advises that "[b]uilding operators should consider installation of the highest efficiency filters that do not exceed the static pressure limits of the HVAC

[322] A minority of states have laws that limit agencies from adopting a regulation that is more stringent than a corresponding federal rule, though some such laws provide an exception in cases where the agency demonstrates the need for a stricter requirement.
[323] See ELI, Ventilation in Schools: A Review of State Policy Strategies (2023).

system, as specified by the manufacturer or system designer." The guidance also notes that indoor exposures can be further reduced by the use of portable air cleaners.[324]

The regulation establishes several other requirements for covered workplaces, including determining employee exposure to $PM_{2.5}$, training employees, and establishing and implementing a system to communicate wildfire smoke hazards and protective measures "in a language and manner readily understandable by employees."

In addition to the new wildfire smoke rule, Cal/OSHA regulations have long included a section on HVAC system operation and maintenance that applies broadly to places of employment and could help ensure that HVAC filters are maintained properly. 8 Cal. Code Regs. §5142. HVAC systems must be operated continuously (with exceptions) and "maintained and operated to provide at least the quantity of outdoor air required by the State Building Standards Code...in effect at the time the building permit was issued." Systems must be inspected at least annually and "problems found during these inspections shall be corrected within a reasonable time." HVAC inspections and maintenance must be documented in writing, including specific findings and actions taken, and records must be retained for at least five years and made available upon request to the state and to employees.

Cal/OSHA also has in place a heat illness prevention regulation addressing outdoor workplaces, and the agency has issued a proposed heat illness prevention regulation addressing indoor places of employment that would require the use of engineering controls in certain situations.[325]

Oregon Wildfire Smoke Rules for Workplaces

Oregon OSHA adopted its wildfire smoke rules in 2022. Or. Admin. Code §437-002-1081 (general industry), §437-004-9791 (Agriculture). The rules define wildfire smoke as "[e]missions from unplanned fires in wildlands, which may include adjacent developed and cultivated areas to which the fire spreads or from where it originates."

Oregon's rules include a lower $PM_{2.5}$ threshold than the California rule. The rules apply to "public and private sector employers whose employees are or will be exposed to wildfire smoke where the ambient air concentration for [$PM_{2.5}$] is at or above 35.5 $\mu g/m^3$ (Air Quality Index value of 101 for $PM_{2.5}$)." For work that involves "intermittent employee exposure of less than 15 minutes in an hour…for a total exposure of less than one hour in a single 24-hour period," the employer is only required to comply with the rule's information, training, and voluntary respirator provisions.

Like the California wildfire smoke rule, Oregon's rules exempt enclosed buildings and structures if "the air is filtered by a mechanical ventilation system and the employer ensures that windows, doors, bays, and other exterior openings are kept closed, except when it is necessary to briefly open doors to enter or exit." Enclosed vehicles are exempt if "the air is filtered by a properly maintained cabin air filter system, and when the windows, doors, and other exterior openings are kept closed."

For workplaces not exempted, employers must "implement engineering and administrative controls to reduce employee $PM_{2.5}$ exposure to less than 35.5 $\mu g/m^3$ (AQI 101), unless the employer can

[324] Cal. Dept. of Indus. Relations, Protecting Indoor Workplaces from Wildfire Smoke with Building Ventilation Systems and Other Methods.
[325] Cal. Dept. of Indus. Relations, Heat Illness Prevention in Indoor Places of Employment.

demonstrate that such controls are *functionally impossible*, or would prevent the completion of work." (Italics added.)[326] Appropriate engineering controls may include "temporarily relocating outdoor workers to available indoor areas or vehicles where the air is adequately filtered, or using portable air purifiers equipped with HEPA filters (or similar high-efficiency air filters) that are sufficient in number and performance for the size of the enclosed area where used."

Under the rule, if employee $PM_{2.5}$ exposure exceeds the rule's threshold level after implementation of engineering and administrative controls, employers must provide employees appropriate NIOSH-approved filtering facepiece respirators for voluntary use to protect against wildfire smoke "when such use would not expose the wearer to a hazard associated with a substantially more serious injury or illness than the potential acute health effects of wildfire smoke exposure." The rule also sets more stringent $PM_{2.5}$ thresholds at which the use of filtering facepiece respirators or respirators meeting federal OSHA standards is mandatory.

The rule includes several other requirements for covered workplaces. Employers are required to monitor employee wildfire smoke exposure when employees are, or are likely to be, exposed to $PM_{2.5}$ levels above the rule's threshold. Employers must also develop and implement a two-way system to communicate wildfire smoke information between supervisors and employees and must provide annual information and training on health effects, protective measures, and monitoring "in a language and vocabulary readily understood, and in a manner that facilitates employee feedback."

Oregon OSHA's separate rules addressing heat illness apply to both indoor and outdoor employment whenever an employee performs work activities where the heat index is 80 degrees or higher. The rules exempt buildings and structures if they "have a mechanical ventilation system that keeps the heat index below 80 degrees Fahrenheit." The rules address drinking water, access to shade, and acclimatization procedures and require covered employers to provide training and to implement an effective heat illness prevention plan. Under the rules, if engineering and administrative controls do not reduce an employee's exposure to an ambient heat index of less than 90 degrees, employers must implement several specified high heat procedures. Or. Admin. Code §§437-002-0156 (general industry), 437-004-1131 (agriculture). A separate rule, Heat Illness Prevention in Labor Housing, requires employers to take certain steps listed in the rule if sleeping rooms are not able to maintain an indoor temperature of 78 degrees or less. Or. Admin. Code §437-004-1120.

Washington Wildfire Smoke Rules for Workplaces

In December 2023, the Washington Department of Labor and Industries adopted permanent rules governing wildfire smoke. Wash. Admin. Code §296-307-098 (agriculture), ch. 296-820 (other industries). The rules, which follow emergency rules issued in 2021 and 2022, define wildfire smoke to include "emissions from planned and unplanned fires in wildlands, wildland urban interface, agricultural operations, or adjacent developed areas." The rules exempt buildings and structures that keep windows, doors, and other openings closed, but unlike in California and Oregon, such buildings do not have to provide mechanical filtration in order to be exempt.

[326] This provision also applies to worker housing not exempted by the rule (e.g., buildings not filtered by a mechanical system). Or. Occup. Safety & Health Div., Explanation of Rulemaking: Protection from Wildfire Smoke Rules at 16 (2022).

For workplaces that are not exempt, Washington's wildfire smoke rules require that employers "must implement effective exposure controls whenever feasible" when the $PM_{2.5}$ level is 35.5 µg/m^3 (AQI 101) or more. Under the rules, such controls include providing "enclosed buildings, structures, or vehicles where the air is adequately filtered" and providing "portable HEPA filters in enclosed areas," as well as relocating work, changing work schedules, providing rest periods, and avoiding work that creates additional exposures to dust, fumes, or smoke. The rules also "encourage" covered employers to implement such exposure controls and to provide respiratory protection at lower outdoor $PM_{2.5}$ levels – 20.5 µg/m^3 (AQI 69) or higher. Respiratory protection must be provided at $PM_{2.5}$ levels of 35.5 µg/m3 or more, and at levels of 500.4 µg/m^3 or more the employer must provide and require use of respiratory protection as specified in the rules.

The rules include other measures that apply to covered workplaces. Employers must determine the current $PM_{2.5}$ levels for covered workplaces "periodically as needed" and must develop a hazard communication plan that includes, among other things, informing employees when $PM_{2.5}$ thresholds listed in the rules are reached. Employers must provide information and training and must develop a wildfire smoke response plan as part of the employer's written accident prevention program. The rules list several mandatory response plan elements, including the methods that will be taken to protect employees from wildfire smoke and to respond to exposure symptoms.

Earlier in 2023, Washington adopted new heat exposure rules that apply mainly to outdoor workplaces but provide that work inside structures "may be considered an outdoor environment if the environmental factors affecting temperature are not managed by engineering controls." The rules define engineering controls to include "the use of devices to reduce exposure and aid cooling, not including wearable items." Among other things, the rules require certain high heat procedures (e.g., cool down periods) to be implemented unless engineering controls are used to lower employee exposure to below 90 degrees. WAC §296-62-095.

Washington's Temporary Worker Housing Rule

Federal rules establish standards that apply to the accommodations employers must provide for certain temporary agricultural employees. The rules cover issues such as heating, sanitation, and minimum size but do not address filtration or indoor temperature standards. 29 C.F.R. §1910.142(a); U.S. Dept. of Labor, Fact Sheet #26G: H-2A Housing Standards for Rental and Public Accommodations (2022). See also 29 C.F.R. §§500.130-135. State and local laws may address worker housing through general housing construction and maintenance laws or through special rules setting standards for worker housing.

Washington amended its temporary worker housing (TWH) rules in September 2023, building on emergency rules that had been in place during the COVID-19 pandemic. The Department of Health (DOH) and the Department of Labor and Industries (LNI) each have authority to oversee TWH for agricultural employees, and each agency adopted rules. WAC §§296-307-16101, et seq (labor); WAC ch. 246-358 (health). The rule revisions focus on infectious disease control, but new filtration requirements and other provisions may help reduce wildfire smoke exposure as well.

Existing TWH facilities in Washington must have either natural ventilation or mechanical ventilation in accordance with the applicable ASHRAE standard. WAC §§296-307-16145(11), 246-358-075(11). The rules include certain requirements for TWH facilities that provide mechanical ventilation (other than kitchen or bath exhaust fans). WAC §§296-307-16146, 246-358-076. For example, the operator must maintain the HVAC system according to the manufacturer's specifications and operate it to provide "fresh and filtered air." More specifically, maintenance staff or contractors must verify that:

- Mechanical ventilation system filters have a MERV rating of at least 13 or equivalent. If the mechanical ventilation system does not support MERV 13 filters, the operators must use "the highest MERV rating filter supported by the mechanical ventilation system."
- Filters in any mechanical ventilation system are in good repair and replaced in accordance with manufacturer's instructions.
- Maintenance checks are performed at the beginning of each growing season, with additional checks based on manufacturer recommendations.
- Written maintenance records are maintained, including the condition of filters and documentation of filter selection, "including a selection reason if less than MERV 13 filtration is used."

Buildings with mechanical ventilation must also verify that outdoor air is maximized except when "external conditions pose health and safety risks." TWH operators must instruct occupants to temporarily shut down the ventilation system and/or to close windows and other openings when such conditions exist. Separate state rules governing TWH construction address indoor temperature – e.g., when "the TWH dwelling unit temperature can rise above [90 degrees] during occupancy, the TWH dwelling unit must provide a coolant system to maintain a temperature at or below" 90 degrees. WAC §246-359-580.

DOH and LNI share responsibility for enforcing the TWH rules. DOH does an annual preoccupancy inspection, as well as an occupancy inspection to make sure the housing is being maintained. Both agencies also inspect upon complaint. (ELI Comm. with Wash. LNI, July 2023).

Rental Housing Requirements

Rental properties make up around one-third of occupied housing units in the U.S.[327] Households that rent their homes have lower annual income on average than owner-occupied households – $49,000 compared to $92,000.[328] Rents have been increasing in recent years, and lower-income households often have limited options for affordable housing.[329] A 2020 Government Accountability Office report found that "[h]ouseholds with low incomes…or with rent burdens comprised half or more of renters living in units with substantial quality issues…"[330]

Many states have laws and regulations establishing minimum conditions in rental housing, though few of those policies explicitly address indoor air quality or require measures to protect tenants from indoor exposure to wildfire smoke and other air pollutants. To make rental housing healthier and more resilient to wildfire smoke and other emergencies, jurisdictions could incorporate requirements for air filtration and cooling into existing or new rental housing policies and could bolster enforcement of those measures.

Model Housing Codes

Housing codes (also called property maintenance or sanitary codes) are the primary regulatory vehicle for establishing and enforcing minimum health and safety standards in existing rental housing. Housing codes are most often adopted at the local level, but a small number of states have adopted a statewide minimum housing code. State and local housing code provisions apply not only to market-rate rental properties, but also to many federally-funded rental properties, which are also subject to separate federal regulations.[331] Local officials usually have authority to enforce housing codes by conducting inspections and pursuing legal action in the event of noncompliance.

Jurisdictions may adopt or revise a model housing code, such as the ICC's International Property Maintenance Code (IPMC) or the National Healthy Housing Standard.

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[327] U.S. Census Bureau, American Community Survey (2022).

[328] Id. The GAO found that in 2017, 48 percent of renter households were "rent burdened—that is, they paid over 30 percent of income for rent." U.S. GAO, Rental Housing: As More Households Rent, the Poorest Face Affordability and Housing Quality Challenges (2020).

[329] See Center For Budget and Policy Priorities, Addressing the Affordable Housing Crisis Requires Expanding Rental Assistance and Adding Housing Units ("Between December 2017 and September 2022, the median rent for newly leased units rose nearly 32 percent).

[330] U.S. GAO, RENTAL HOUSING: As More Households Rent, the Poorest Face Affordability and Housing Quality Challenges at 29 (2020). See also Harvard Univ., America's Rental Housing 2022 at 20 (2022) (finding that "10 percent of renter households earning under $15,000 a year lived in inadequate housing in 2019, twice the share of households making $75,000 or more").

[331] Federal regulations establish standards for HUD housing programs. For example, units must "be free of health and safety hazards that pose a danger to residents," including extreme temperature. 24 C.F.R. §5.703(e). In 2023, HUD established the National Standards for the Physical Inspection of Real Estate (NSPIRE) program to govern inspections under HUD housing programs. See U.S. HUD, National Standards for the Physical Inspection of Real Estate (NSPIRE).

International Property Maintenance Code. Many jurisdictions across the U.S. have adopted a version of the IPMC.[332] The IPMC does not address smoke exposure or air filtration expressly but it includes certain general provisions that could potentially be applied where there are sustained unhealthy housing conditions due to severe wildfire smoke. For example, IPMC Section 301.2 prohibits a person from allowing another person to occupy premises that are "not in a sanitary and safe condition and that do not comply with the requirements" of the code. The IPMC section governing mechanical systems does not require filtration or air conditioning; however, Section 603.1 requires maintenance of equipment that is provided by the landlord: "Mechanical equipment…shall be properly installed and maintained in a safe working condition, and shall be capable of performing the intended function."

Model Healthy Housing Standard. The National Healthy Housing Standard (NHHS) is a model code developed by the National Center for Healthy Housing and the American Public Health Association.[333] The NHHS addresses a wide range of measures to reduce indoor contaminant exposures. For example, the model code requires a mechanical or natural ventilation system that complies with ASHRAE Standard 62.2 and includes a detailed section on air sealing. NHHS §§5.3, 5.4. Facilities for heating, cooling, ventilation, and humidity control must be "maintained in good working condition and operated when necessary for the health and comfort of the occupants." NHHS §5.1. A "stretch" provision of the code requires maintaining the indoor temperature below a maximum of 85 degrees through mechanical air conditioning, ventilation systems, or passive design features. NHHS §5.2.

Model Landlord-Tenant Laws

Nearly all states have enacted laws governing the landlord-tenant relationship. These laws establish the rights and responsibilities of landlords and tenants but, in contrast to housing codes, are enforced by the parties rather than by government agencies. Landlord-tenant laws set forth the legal remedies that a tenant may pursue to remedy unsafe or dangerous condition in a rental dwelling. While the laws do not typically set specific requirements for ventilation, they often require premises to be maintained in a habitable condition and to comply with applicable housing codes.

Uniform Residential Landlord and Tenant Act. Many state landlord-tenant laws follow closely a model law, the Uniform Residential Landlord and Tenant Act (URLTA). This 1972 model law was revised in 2015 and adopted as the Revised Uniform Residential Landlord and Tenant Act (RURLTA), though current state adoptions of the Act are based largely on the earlier version.[334]

The URLTA and RURLTA include minimum standards of habitability, requiring landlords not only to comply with applicable building and housing codes, but also to maintain the premises in a habitable condition and make necessary repairs. URTLA §2.104(a)(2); RURLTA §302. Some state landlord-tenant laws incorporate references to health and safety in these basic habitability provisions. For example, Maryland's landlord-tenant law "provides a remedy and imposes an obligation upon landlords to repair and eliminate conditions and defects which constitute…a serious and substantial threat to the life, health or safety of occupants…" Md. Real Prop. §8-211(e). In Idaho, a tenant may file a legal action against a

[332] Intl. Code Council, 2024 Intl. Prop. Maintenance Code (IPMC).
[333] Natl. Center for Healthy Housing and American Public Health Assoc., National Healthy Housing Standard (rev. 2018).
[334] Uniform Law Comm., Uniform Residential Landlord and Tenant Act and Residential Landlord and Tenant Act, Revised (2015).

landlord for damages and specific performance for, among other things, "maintaining the premises in a manner hazardous to the health or safety of the tenant." Idaho Id. Stat. 6-320.

The URLTA and RURLTA do not require air filtration or air conditioning but, like the International Property Maintenance Code, they require the landlord to maintain all facilities and appliances that are supplied to a tenant in good repair. The RURLTA added a requirement for "adequate ventilation and heating facilities that conform to law and are maintained in good working order." The RURLTA also added a requirement for ensuring "effective waterproofing and weather protection of the roof and exterior walls, including windows and doors." RURLTA §302(a).

Recent State Laws

Few, if any, state (or local) laws establish express requirements for landlords to take the steps needed to reduce indoor exposure to wildfire smoke and other outdoor air pollutants. The general habitability standards found in many existing policies may provide recourse for tenants in some extreme situations, but they are not likely to be effective in most cases where tenants are exposed indoors to wildfire smoke or excessive heat.

Filtration. Current state laws typically do not expressly require filtration for existing rental housing, though they may require that any facilities and equipment supplied by the landlord be maintained in good repair. Moreover, housing codes and landlord tenant laws often require rental housing to comply with other state and local laws such as building codes. Thus, if the building code applicable to a rental property required high-efficiency filtration, the landlord would have a responsibility to provide and maintain that level of filtration. State and local housing codes could help ensure compliance with such building code requirements by, e.g., incorporating HVAC filter checks into their housing inspections programs.

Given that most of the existing rental housing stock is not subject to building codes with high-efficiency filtration requirements, states should consider establishing filtration provisions directly in their housing codes or landlord-tenant laws. A requirement for enhanced filtration could be limited to air pollution emergencies, though a more health-protective and straightforward approach would be an ongoing requirement for mechanical systems to use MERV 13 filters or as close to that level as the system allows, as documented by an HVAC professional. Alternatively, policies could require compliance with ASHRAE 62.2, which now requires MERV 11 filters. Housing policies could require landlords to supply portable air cleaners during air quality emergencies when high-efficiency filtration cannot be supplied by the mechanical system.

Indoor Temperature Standards and Related Requirements. Standards and requirements to protect against excessive heat are incorporated into some local housing codes and ordinances,[335] though

[335] See, e.g., Montgomery County (MD) Mun. Code §§26-7, 29-30 (requiring rental housing (except single-family detached homes) to maintain a temperature of no more than 80 degrees in each habitable space or provide an air conditioning system capable of doing so); Dallas Mun. Code §27-11(e) (requiring owners of rental housing units to "provide, and maintain, in operating condition, refrigerated air equipment capable of maintaining a room temperature of at least 15 degrees cooler than the outside temperature, but in no event higher than 85 ° F in each habitable room"); Arizona 211, What are my Rights? (temperature ordinances for cities of Phoenix, Tempe, Tucson).

few if any state housing codes or other state laws and regulations currently include such measures. California and Oregon took steps in this direction through legislation enacted in 2022.

- *California* AB 209, which addresses a variety of energy and climate issues, directs the Department of Housing and Community Development (DHCD) to submit policy recommendations to the legislature by January 1, 2025, to ensure that residential dwelling units can maintain a safe maximum indoor temperature. The recommendations must take into account a variety of factors, including state climate goals, regional temperature differences, and "various methods for reducing indoor air temperatures, including, but not limited to, technical feasibility, building and site electrical system limitations, cost barriers, electric utility capacity limitations, state and federal statutory requirements, and other relevant factors." In developing the recommendations, DHCD must consult with other state and local agencies, as well as with community-based organizations working in the areas of housing and health, tenant rights, and environmental justice. DHCD has contracted with University of California Berkeley to help develop the policy recommendations and has created a workgroup comprising stakeholders listed in the law to provide input on the recommendations.[336]

- *Oregon* has directly addressed cooling as a habitability issue in the state landlord-tenant law. The state's 2022 legislation on extreme heat took the notable step of requiring buildings permitted after April 1, 2024, to provide rental dwellings with "adequate cooling facilities":

  > A landlord shall at all times during the tenancy maintain the dwelling unit in a habitable condition. For purposes of this section, a dwelling unit shall be considered unhabitable if it substantially lacks…For a dwelling unit in a building where building permits for its construction were issued on or after April 1, 2024, adequate cooling facilities that: (A) Provide cooling in at least one room of the dwelling unit, not including a bathroom; (B) Conform to applicable law at the time of installation and are maintained in good working order; and (C) May include central air conditioning, an air-source or ground-source heat pump or a portable air conditioning device that is provided by the landlord." Or. SB 1536 (Sec. 11); Or. Rev. Stat. 90.320(1)(m).

  Oregon's 2022 law on extreme weather events addresses *existing* rental dwellings that may lack air conditioning. Under that law, landlords may not prohibit or restrict a tenant from installing or using a portable cooling device ("air conditioners and evaporative coolers, including devices mounted in a window or that are designed to sit on the floor") with certain exceptions addressing safety, property damage, and power service capacity. A landlord who must limit portable cooling devices for reasons allowed by the law must prioritize allowing the use of devices for individuals who require a device to accommodate a disability. The law requires that rented manufactured housing connected to electrical service "must have sufficient amperage to meet reasonable year-round needs for electrical heating and cooling." The legislation included $2 million for the biennium for a new program to assist landlords with grants and information for creating or operating "one or more private community cooling spaces available to the landlord's tenants during [an] extreme heat event that are on or near the premises."[337] Or. SB 1536 §§11, 12, 24.

[336] See Cal. Dept. of Housing & Comm. Devt., Assembly Bill 209 Workgroup Charter.
[337] See Energy Trust of Oregon, Landlord Provided Cooling Space Initiative – Funding and Resources for Multifamily Properties Without In-Unit Cooling (2023).

Colorado's Revised Landlord-Tenant Law:
Requiring Remediation in Rental Housing Damaged by Wildfires and Other Disasters

Colorado recently took the unusual step of revising its landlord-tenant law to include a requirement specific to wildfires and other disasters. The legislation added a provision governing remediation of damages following "environmental public health events" such as wildfires, floods, or toxic contaminant releases "that could create negative health and safety impacts for tenants that live in nearby residential premises." Co. HB 23-1254; Co. Rev. Stat. §38-12-502(4.5). The central requirement of the new legislation is compliance with third party standards for post-disaster remediation, which could include cleanup that addresses smoke, ash, or other residual air contaminants following a fire.

Landlords who receive notice from a tenant of a "habitability issue regarding a residential premises that has been damaged due to an environmental public health event" must comply with "applicable standards from the American National Standards Institute…for the remediation and clean up" within a reasonable amount of time, at the landlord's expense. Co. Rev. Stat. §§38-12-505(1)(b), 38-12-503(2.7)(b). The law does not specify particular ANSI standards that must be met. Failure to comply with the requirement after receiving notice of the condition renders the premises uninhabitable and constitutes a breach of the implied warranty of habitability, and the landlord must provide documentation of compliance to the tenant. Co. Rev. Stat. §38-12-503(2), (2.7)(c), (2.7)(d).

The law establishes tenant remedies, such as terminating the lease if the landlord has not remediated the premises to a safe condition within 60 days and has not provided adequate alternative housing. Co. Rev. Stat. §§38-12-507(4), 38-12-503(4). Tenants who are members of a "vulnerable population" have broader termination options that could potentially apply to situations involving wildfire smoke exposure. Such tenants may terminate the lease "after the residential premises has been damaged due to an environmental public health event" and need not need wait for 60 days to terminate. The tenant may terminate if they have given the landlord notice that "the residential premises is not safe for habitability due to damage from an environmental public health event" and the landlord "has not been able to remediate the conditions of the residential premises so that it is safe for habitability for the tenant who is a member of a vulnerable population" or to provide "adequate alternative housing accommodations" during remediation. Co. Rev. Stat. §38-12-507(5). The law defines "vulnerable population" to include children, individuals with asthma or disabilities or who are pregnant, or "any other group of individuals that has health conditions that could make the individuals more susceptible to environmental contaminants." Co. Rev. Stat. §38-12-502(10).

Enforcement of Minimum Housing Requirements

The extent to which housing condition standards are effective in reducing indoor air risks depends in part on how those standards are enforced. State landlord-tenant laws are enforced privately, but most tenants lack legal representation and information about legal remedies. State and local governments could assist tenants in enforcing housing standards by, e.g., developing written educational materials, strengthening procedural provisions in landlord-tenant laws, establishing specialized housing courts, and

providing tenants legal representation. In the *District of Columbia*, tenants can bring a case against landlords for violating the housing code on an expedited basis; a court-created form to initiate the case provides a checklist of potential housing violations, including inadequate ventilation and inadequate air conditioning.[338] In *Boston*, the city worked with Greater Boston Legal Services to create a new online tool to make it easier for tenants to respond on their own to an eviction case.[339]

Government enforcement of housing codes is critical to ensuring compliance with habitability requirements. States could assist local code enforcement agencies in identifying provisions in housing codes that can be applied to reduce wildfire smoke exposure and could provide support for local agencies to carry out housing code inspections in anticipation of or at the onset of wildfires or other high-pollution events in the area. States could also build on the example of the *Rhode Island* Department of Health, which has created a program to help health care providers refer people with asthma or other medical conditions to the appropriate housing inspection agencies to address indoor asthma triggers.[340] Another code enforcement resource is the National Center for Medical-Legal Partnership, an innovative program through which health care providers refer patients to legal service providers who help them work with code agencies and landlords to address asthma triggers and other substandard conditions in their homes.[341]

School Facility Requirements

This section highlights state policies enacted over the past few years that address filtration and indoor temperature standards in existing schools, apart from the occupational safety and health rules discussed earlier in this section. The information is drawn largely from ELI's 2023 report, Ventilation in Schools, which provides a more comprehensive discussion of the subject.[342]

The coronavirus pandemic highlighted both the need for proper ventilation and filtration in schools and the fact that millions of students attend schools with inadequate ventilation and indoor air quality. Local education agencies have primary responsibility for managing their facilities, and many schools have taken important steps to implement ventilation and indoor air quality best practices, both before and during the pandemic. However, without statewide policies, facility practices and conditions may vary significantly from one school district to another.

Few states have established minimum air filtration standards for existing schools other than the building code requirement in effect at the time of construction or system installation, and those building codes typically include minimal if any filtration efficiency standards. As states begin to strengthen the ventilation, filtration, and thermal comfort standards in their building codes, new and renovated schools will be required to maintain and operate the buildings to meet those standards. Apart from building codes, most states have health, education, or workplace laws or regulations that address facility

[338] See District of Columbia Courts, Housing Conditions Calendar; Superior Court of the District of Columbia, Civil Actions Branch, Verified Complaint to Enforce Housing Regulations.
[339] See Greater Boston Legal Svcs., Massachusetts Defense for Eviction (MADE): Self-Guided Eviction Help.
[340] See R.I. Dept. of Health, Breathe Easy at Home Project.
[341] See Natl. Center for Medical-Legal Partnership, National Center for Medical-Legal Partnership.
[342] ELI, Ventilation in Schools: A Review of State Policy Strategies (2023).

conditions to some extent. However, those policies typically lack clear ventilation, filtration, and temperature requirements, and they often do not establish strong compliance oversight mechanisms.

It is important for states to review their school health and safety policies to identify how best to equip school facilities to protect students and staff from wildfire smoke and other indoor air contaminants.

Filtration Requirements for Existing Schools. Few states establish filter efficiency requirements for existing schools, independent of the applicable building codes.

- In 2022, *California* legislation established new requirements for minimum filtration efficiency and ventilation in existing schools. Schools must "install filtration that achieves MERV levels of 13 or higher to the extent determined to be feasible and appropriate for the existing HVAC system, as determined by the school." If a school concludes that upgrading to MERV 13 or higher is not feasible, it must "install filtration that achieves the highest MERV level that the school determines is feasible without significantly reducing the lifespan or performance of the existing HVAC system." Cal. AB 2232; Cal. Educ. Code §17661(c).

  In addition, existing schools that have HVAC systems must ensure that their "facilities, including, but not limited to, classrooms for students, have HVAC systems that meet the minimum ventilation rate requirements set forth in [the *current* state building code]…unless the existing HVAC system is not capable of safely and efficiently providing the minimum ventilation rate." (The current state building code requires classroom ventilation of at least 15 cfm per person. 24 Ca. Code Regs Pt. 6 §120.1(b).) A school that cannot meet this standard must ensure that the HVAC system meets the minimum ventilation rates in effect when the HVAC system permit was issued. Cal. AB 2232; Ca. Educ. Code §17661(b).

  The inability of a school's HVAC system to meet the new filtration and ventilation standards must be documented in the school's annual HVAC inspection report required under Cal/OSHA regulations and available to the public upon request. Cal. AB 2232; Cal. Educ. Code §17661(b)(2), (c)(2).

- *Montana*'*s* health agency has adopted regulations that address the growing problem of wildfire smoke episodes by including requirements for K-12 public schools relating to infiltration of outdoor air and filtration efficiency, as well as ventilation system inspections. Mt. Admin. Code §§37.111.826, .827. Under the rules, air filters must have a MERV value of between 8 and 13 (unless other types of non-MERV rated filters are used). The rules also state that the "department recommends that schools with ventilation systems using MERV rated air filters change their filters to MERV 13 or greater during times of poor outdoor air quality." In addition, ventilation systems must undergo annual checks by school staff to ensure they are operating within manufacturer parameters, and the school must complete an annual IAQ inspection "using the Walk Through Inspection Checklist from EPA's Indoor Air Quality Tools for Schools or other department-approved inspection form."

  The rules require schools to "have a protocol in place on how to limit the infiltration of outside air into the school during poor air quality conditions." (See Box.)

- In *Connecticut*, a 2022 law requires that schools undertake comprehensive five-year ventilation evaluations. Although the law does not set a minimum filtration efficiency requirement, it may lead

to the use of high-efficiency filters in some existing schools because the assessments must include "testing for maximum filter efficiency," and the inspection report must describe corrective actions, including "installation of filters meeting the most optimal level of filtration available for a given [HVAC] system." Ct. HB 5506; Ct. Stat. §10- 220(d)(3).

A considerable number of states have education or health laws and regulations that address the maintenance of ventilation systems by requiring schools to conduct routine facility inspections and maintenance and/or develop maintenance plans. These policies could be strengthened by expressly incorporating filter maintenance requirements such as those set forth in ASHRAE 62.1.[343]

Filtration Requirements for State-Funded School HVAC Upgrades. Funding is critical for realizing improved facility conditions in low-wealth, rural, and other historically underserved communities. During the COVID-19 emergency, several states developed programs to fund school HVAC upgrades that included minimum filtration requirements for funded projects.[344]

California's utility-funded school HVAC grant program, CalSHAPE, was established by the legislature in 2020. The legislation requires that the program offer funds to schools that are in underserved communities first. Cal. AB 841. *New Jersey* enacted legislation in 2021 creating a similar program, the School and Small Business Ventilation and Energy Efficiency Verification and Repair program, which prioritizes funding for projects in underserved communities. N.J. SB 3995. In both programs, funded schools must install filtration with a rating of MERV 13 or better in the HVAC system "where feasible," qualified testing personnel must "review system capacity and airflow to determine the highest MERV filtration that can be installed without adversely impacting equipment," and schools must "replace or upgrade filters where needed, and…verify that those filters are installed correctly." Recommendations for additional maintenance, replacement, or upgrades to allow for more protective filtration must be recorded in the required assessment report. Cal. Pub. Util. Code §1623; N.J. Stat. §48:3-106.4.

A 2023 *Minnesota* law created an air ventilation pilot program that will award $900,000 in grants to public schools for HVAC assessments, upgrades, and repairs. The law requires funded projects to document that "either MERV 13 filters have been installed or…that the maximum MERV-rated filter that the system is able to effectively handle has been installed." Mn. HF 2310, §§7, 8; Minn. Stat. §123B.663 subdiv. 6.[345]

[343] Id. at 36-37.
[344] See ELI, State Funding for School Ventilation: A Review of Selected Policies, 2020-2022 (2023).
[345] See Mn. Commerce Dept., Air Ventilation Pilot Grants.

Montana's Model Air Quality Monitoring and Response Policy for Schools

Montana state health rules require schools to have in place a protocol for limiting outside air infiltration during periods of poor outdoor air quality, and the state public health agency developed a model protocol to assist schools in complying with this requirement. According to agency officials, some school wellness policies have already incorporated the model, which includes the following filtration and other measures for a school to take.

1. Determine outdoor air quality using the DEQ $PM_{2.5}$ readings and/or Air Quality and Activity Guidelines…the school may contact the local county air quality specialist if available or the DEQ Air Quality Monitoring Section…for assistance.

2. Teachers and staff will be asked to close classroom windows to prevent smoke from easily entering the building through these openings.

3. Signage will be placed on exterior doors with instructions to keep doors closed as much as possible and discourage propping doors open during times of poor outdoor air quality.

4. HVAC system efficiency will be assessed and adjustments will be made to reduce the amount of outdoor air introduction into the building. Changes made to the operation of the HVAC system comply with the most recent building and mechanical codes adopted by the state of Montana and align with most recent ASHRAE standards to the extent possible.

5. HVAC system filters will be changed to efficiency MERV 13 or greater depending on system capabilities.

6. Individual air conditioning units will be switched to recirculate if possible.

7. HEPA air purifier units will be placed in rooms with sensitive individuals (i.e., students with asthma and other lung or heart conditions).

8. A clean air space will be established where smoke sensitive individuals can go for relief. Targeted HVAC system adjustments and stand-alone HEPA air purifiers can help clean the air in these spaces.

9. Passive vents allowing outdoor air to infiltrate the building will be shut if possible.

10. School officials will notify parents of the precautions taken to maintain the cleanest indoor air possible.

Sources: Model Air Quality Monitoring & Response Policy (on file with ELI); ELI Communication with Mt. Dept. of Public Health and Human Services (July 2023).

Temperature Standards. Recent laws in Delaware and Connecticut require the state to adopt temperature standards or guidelines for schools. The 2023 *Delaware* law requires the Division of Public Health to establish, before January 2024, a "routine indoor air quality monitoring program and standards that includes allowable ranges for temperature and humidity in public schools," taking into consideration "indoor air quality recommendations provided by OSHA and industry best practices, such as [ASHRAE]

Standard 62.1." Del. SB 270; Del. Code, t. 14, §§4301—4308. In *Connecticut*, 2023 legislation strengthens the state's existing law relating to IAQ in schools. Among other things, the legislation directs the Department of Public Health to develop guidelines for an optimal thermal comfort range of 65-80 degrees for school buildings and facilities, with a larger optimal thermal comfort range allowed for gymnasiums and natatoriums. Ct. Public Act 23-167.

States may also have requirements that establish maximum temperature parameters for HVAC performance. For example, *Arizona's* minimum school facilities guidelines establish that a school facility "shall have an HVAC or other system capable of maintaining a temperature between 68° and 82° F under normal conditions" for occupied classrooms. Ariz. Admin. Code §R7-6-213. *New Mexico* statewide adequacy standards for public school buildings, which are "intended for use in the evaluation of baseline requirements for existing public school facilities," require that "all occupiable spaces have an HVAC system that continually moves air" and that is "capable of maintaining a temperature between sixty-eight and seventy-five degrees…with full occupancy." N.M. Admin. Code §§6.27.30.2, 6.27.30.12. *Indiana* law requires the state health agency to conduct school IAQ inspections upon complaint, and agency rules set forth inspection criteria that include: "Where provided air-conditioning systems shall be capable of providing and shall be operated to maintain a temperature not to exceed" 78 degrees and 65 percent relative humidity during periods of student occupancy. 10 In. Admin. Code §33-4-4(b).

Child Care Licensing Regulations

All 50 states and the District of Columbia require licensing of child care facilities and have programs to oversee a wide range of licensing requirements, including environmental health and safety standards.[346] Child care licensing requirements vary from state to state, and within a state the requirements often differ somewhat based on the size and type of child care facility (e.g., centers versus home-based). Some states also have separate health or sanitation codes that apply to child care facilities. Physical facility standards are one of several core components of state licensing regulations. Following are examples of provisions governing filtration/ventilation and maximum temperature standards.[347]

Filtration and Ventilation. Virtually all states have child care regulations that require mechanical or natural ventilation, though few if any of those policies specifically require filtration or establish a minimum filtration efficiency beyond requirements that were established in the applicable building code. Some state licensing rules contain more general ventilation or health standards that could potentially be applied to address indoor exposure to smoke during wildfire events. For example, *Iowa's* child care center rules require that "[s]ufficient ventilation is provided to maintain adequate indoor air quality." 441 Iowa Admin. Code §109.11(3). In *Alaska*, licensing rules require that natural or mechanical ventilation be provided "to keep air fresh and to prevent the accumulation of heat, steam, condensation, vapors, smoke, or fumes." 7 Ak. Admin. Code §10.1035. Early learning providers in *Washington* "must observe weather conditions and other possible hazards to take appropriate action for child health and safety.

[346] For links to all state child care licensing rules, see U.S. Dept. of Health and Human Svcs. (DHHS), National Database of Child Care Licensing Regulations. Federal rules require states to establish certain licensing requirements for providers who accept federal child care funds. See U.S. DHHS, Child Care and Development Block Grant Act (CCDBG) of 2014. Federal rules also establish requirements for Head Start providers. U.S. DHHS, Head Start Policy and Regulations.
[347] For a comprehensive review of environmental health provisions in state child care licensing rules as of 2014, see ELI, State Policies for Advancing Environmental Health in Licensed Child Care Facilities (2015).

Conditions that pose a health or safety risk may include, but are not limited to: Air quality emergency ordered by a local or state authority on air quality or public health…" Wash. Admin. Code §110-300-0147.[348]

Requirements for maintaining ventilation systems in good repair could be applied to require adequate maintenance and replacement of system filters. *New Jersey* specifically requires child care centers to ensure that ventilation outlets are clean and free from obstructions and that filters are replaced "when saturated." N.J. Admin. Code §3A:52-5.3(a)(15).

Maximum Indoor Temperature. Most state child care licensing regulations specify a minimum indoor temperature, but only some of those states also specify a *maximum* facility temperature or include other provisions addressing high indoor temperatures. For example:

- Child care center rules in *South Dakota* require heating and cooling systems to maintain a temperature between 65-75 degrees. S.D. Admin. Code §67:42:17:32.
- In *North Carolina*, temperatures in rooms where infants are sleeping must not exceed 75 degrees; indoor areas used by children in family child care homes must be "ventilated when the temperature is above 85 degrees." 10 N.C. Admin. Code §§09.1724(a)(6), 09.1707(6).
- *Arizona*, *Washington*, and *New Mexico* are examples of states that set a maximum temperature of 82 degrees in some or all licensed child care facilities. Ariz. Rules §§R9-5-501, R9-3-501; Wash. Admin. Code §110-300-0147; N.M. Admin. Code §8.16.2.29. The Washington rules further state that if the indoor licensed space is hotter than 82 degrees, the child care provider "must use climate control devices that are inaccessible to children to bring the temperature within the required range."
- *California's* rules for child care centers require that a "comfortable temperature for children shall be maintained at all times." Child-occupied rooms must maintain a maximum temperature of 85 degrees; in "areas of extreme heat the maximum shall be 20 degrees…less than the outside temperature." 22 Cal. Code. Regs. §101239.

State child care licensing rules may include more general heat-related standards instead of a maximum temperature. For example, in *Oregon* child care centers and family child care homes, room temperatures may not be "so warm as to be dangerous or unhealthy in the center when children are present." Or. Admin. Code §§414-300-0180, 414-350-0140. *Massachusetts* requires child care providers to "take appropriate measures to protect children from health risks associated with excessive heat," and *Iowa* requires child care centers to provide "[s]ufficient cooling…to allow children to perform tasks without being excessively warm or subject to heat exposure." 606 Code Mass. Regs. §7.07(10); 441 Iowa Admin. Code §109.11(3).

[348] As of late 2023, Montana had proposed revisions to its child care licensing rules that would require most child care facilities to properly maintain centralized ventilation systems and air filters. Facilities would also be required to use state health department guidelines to determine local air quality conditions and decide whether to cancel outdoor activities. Mt. Dept. of Public Health & Human Svcs., Notice of ARM Proposal with Public Hearing (10/20/2023).


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