Indoor Wood Burning

Policies to Reduce Emissions and Improve Public Health

ENVIRONMENTAL LAW • INSTITUTE®

APRIL 2021

The Environmental Law Institute (ELI) is grateful to the many individuals who shared their expertise in providing information for this report and in reviewing drafts.

Funding for the report was provided by the U.S. Environmental Protection Agency (EPA). The contents of the report are the responsibility of ELI. The views expressed herein should not be attributed to EPA, nor should any official endorsement be inferred.

The Environmental Law Institute makes law work for people, places, and the planet. Since 1969, ELI has played a pivotal role in shaping the fields of environmental law, policy, and management, domestically and abroad. Today, in our sixth decade, we are an internationally recognized, nonpartisan research and education center working to strengthen environmental protection by improving law and governance worldwide.

Indoor Wood Burning: Policies to Reduce Emissions and Improve Public Health

Cover Photos: Thomas Oswald, Local Exposure/shutterstock.com; Pgalan/istockphoto.com; Alex Chernenko.

Contents

EXECUTIVE SUMMARY

Public policy plays a central role in preventing and reducing air pollution and protecting public health. This report provides information for policymakers and agencies considering steps to address an important source of air pollution in many communities throughout the United States: residential wood burning. The report describes a variety of policy strategies that have already been adopted at the state, local, regional, and tribal levels. The focus here is on indoor space heating devices – e.g., wood stoves and fireplaces – which account for a large fraction of residential wood burning. Some of the approaches discussed in the report may also be relevant to other types of residential solid fuel burning devices.

Wood Smoke Contains Harmful Pollutants
Wood smoke from residential burning produces numerous air pollutants, including particulate matter, carbon monoxide, nitrogen oxides, and toxic chemicals such as benzene, formaldehyde, and polycyclic aromatic hydrocarbons. Public health research has demonstrated the harms associated with these pollutants – most prominently particulate matter, which is linked to cardiovascular disease, respiratory disease, cancer, and other systemic health effects. Some people are at greater risk of harm from exposure to particulate matter and other pollutants, including children and teenagers, older adults, people with heart disease or lung disease, and people who have been economically or socially disadvantaged.

People are Exposed to Wood-Burning Pollutants Indoors – Even in Households that Do Not Burn Wood
Because we spend the large majority of our time inside buildings – especially inside our homes – most of our exposure to air pollution takes place indoors. Ambient (outside) air pollution can get into homes through cracks, windows, and other openings in a building. Smoke that goes out a chimney can reenter the same home and also enter the homes of neighbors. People who burn wood inside their homes may also be exposed to smoke that escapes the device directly into the living space.

Residential Wood Burning Causes Air Pollution in Many Parts of the United States
Residential wood burning is a significant source of particle pollution in the U.S. Wood smoke has caused some areas of the country to violate federal air quality standards, and this has been a major driver of policy. But the problem is not limited to these "nonattainment" areas. Rural communities – where households are more likely to use wood for heating – may not be covered by the federal regulatory air monitoring network. Wood smoke is often a problem at the neighborhood level, leading residents to call on local agencies for assistance. This report offers a range of strategies for consideration by any jurisdiction seeking to reduce wood-burning emissions and improve public health.

Current Policies Reflect a Range of Regulatory and Non-Regulatory Strategies to Reduce Emissions
The report discusses policies currently in place in dozens of jurisdictions around the country that help advance two complementary goals:

- Changing how and when wood is burned in homes, in order to reduce emissions from existing wood-burning devices; and
- Replacing existing wood-burning devices with lower-emitting devices, including non-wood alternatives.

One important question for policymakers and agencies is what types of heating devices should be allowed or incentivized in government policies and programs. This question is influenced by both the heating options available to households now and the jurisdiction's broader set of energy policies and goals. A common approach has been to promote a switch to new, EPA-certified wood heaters. Recently, some jurisdictions have emphasized non-wood alternatives, for a variety of reasons. Certified wood stoves can still produce excessive wood smoke if not operated properly, and it is challenging to regulate the use of wood heaters in a home. Moreover, EPA and stakeholders have raised concerns about whether the current certification testing requirements for wood heaters reflect the conditions of use in the home and the resulting emissions.

Existing Regulatory Requirements for Indoor Wood Burning Take a Variety of Forms
Laws and regulations throughout the U.S. incorporate the following measures to reduce emissions from indoor wood-burning devices:

- Tightening device emissions and approval standards. Some jurisdictions restrict wood burning – in certain situations or in designated air quality zones – to devices that meet a specified emissions standard or have been approved by the designated state, local, or tribal agency.

- Prohibiting the transfer of noncompliant wood-burning devices. A number of policies broadly restrict the transfer of devices that do not meet specified emissions and certification standards. Several jurisdictions have taken the notable step of prohibiting the transfer of noncompliant devices when a home is sold – an opportunity to expedite the removal of older wood heaters.

- Limiting burning during designated periods of poor air quality. Many jurisdictions, especially those with nonattainment areas, have established "curtailment" programs that restrict or prohibit wood burning when ambient particulate matter levels are elevated.

- Setting performance standards that apply to wood smoke. Many jurisdictions limit the opacity of smoke leaving chimneys, and some go further to prohibit "visible emissions." These standards can help implement other regulatory restrictions, and on their own they can serve as tools for addressing public complaints about wood smoke impacts.

- Establishing operating and maintenance requirements for wood-burning devices. In some jurisdictions, air quality rules or housing codes include general requirements that devices be properly operated and maintained. Additionally, many jurisdictions prohibit the burning of certain materials, and some specifically require the use of seasoned/dry wood, an important measure to reduce emissions.

Financial Assistance is Needed to Help Households Reduce Emissions and Meet Regulatory Requirements
A variety of financial assistance programs have been established to help households replace older wood-burning devices and to adopt other practices to reduce emissions. Given limited resources, coordination among programs is vital in order to maximize funds for lower-income households and those who are at greater risk of suffering health effects from exposure to wood smoke. For programs funding the replacement of older wood heaters, a key issue is what type of new heating devices will be subsidized with government funds. In recent years, some jurisdictions have prioritized their funding to support pellet stoves or non-wood alternatives such as electric heat pumps.

Information and Outreach are Important on their Own and as Elements of Other Policy Strategies
An important step that many jurisdictions can take is to increase awareness of the health risks posed by wood smoke and of the wood-burning practices that are needed to minimize emissions. Government agencies can build on the efforts of programs around the country to develop and disseminate culturally relevant information to communicate these messages. Policymakers can also require that information be provided during commercial transactions such as real estate transfers or sales of wood heaters and firewood. Including information about any applicable restrictions on wood burning may help ensure compliance with those rules.

Community Outreach and Participation are Key Elements of Policy and Program Development
The context for developing policies to address wood smoke includes a long history of wood burning tied to important economic, social, and cultural systems. These and other factors, including the nature and extent of wood burning and wood smoke exposures, come into play in determining what combination of strategies is appropriate for a particular state, locality, or tribe. A robust public participation process can increase awareness, identify opportunities for collaboration among agencies and community members, and build public support for policies and programs.

This report is divided into two parts. Part One presents an overview of the health effects of wood smoke and of wood burning in the U.S., and suggests important considerations for developing policies. Part Two provides a detailed review of ten policy strategies for reducing emissions from wood-burning devices, highlighting examples of laws and regulations currently in effect.

PART ONE: OVERVIEW

Wood Smoke Pollutants and Health

During the winter months, chimney smoke wafts through many communities across the United States. When it is cold outside, millions of households rely on wood stoves as an affordable source of heat or use open hearth fireplaces for warmth and comfort.

Many people have positive associations with the smell of burning wood. But wood-burning devices produce a multitude of air pollutants, most prominent among them particulate matter (PM). Wood burning also releases carbon monoxide, nitrogen oxides, "climate forcing" pollutants such as black carbon and methane, and toxic pollutants such as benzene, formaldehyde, acrolein, and polycyclic aromatic hydrocarbons.[1]

The amount of air pollution produced by wood-burning devices depends in part on the type and design of the device. In general, the less efficient the combustion process, the more smoke and pollutants that result.[2] Traditional (open hearth) fireplaces are generally the least efficient.[3] Older wood stoves tend to be less efficient and more polluting than newer stoves, though any wood heater that is not operated properly can produce excessive smoke.[4] Pellet stoves tend to be lower emitting and more efficient than cordwood stoves.[5]

Weather conditions also help determine the extent of ambient air pollution caused by emissions from wood-burning devices. In particular, winter nights with cold, still air can trap smoke close to ground level rather than dispersing it into the upper atmosphere. As the California Air Resources Board notes: "If you can smell smoke, you are breathing smoke."[6]

Wood smoke pollutants are associated with cardiovascular disease, respiratory illness, cancer, and other health effects. While there are many air pollutants in wood smoke, the U.S. Environmental Protection Agency (EPA) considers particulate matter (also referred to as particle pollution) to be the biggest threat to human health.[7]

---

[1] U.S. EPA, Frequent Questions about Wood Burning Appliances, https://www.epa.gov/burnwise/frequent-questions-about-wood-burning-appliances#pollution; Cal. Air Resources Bd., Wood Burning Handbook, https://ww2.arb.ca.gov/resources/documents/woodburning-handbook; U.S. EPA, Process for Developing Improved Cordwood Test Methods for Wood Heaters at 3 (2016), https://www.epa.gov/sites/production/files/2016-03/documents/discussion_paper_-_process_for_dev_imp_cwtm_030916.pdf. Wood burning can also cause buildup of creosote, a leading cause of home heating fires.

[2] U.S. EPA, Frequent Questions about Wood Burning Appliances, https://www.epa.gov/burnwise/frequent-questions-about-wood-burning-appliances%23pollution.

[3] Cal. Air Resources Bd., Wood-Burning Handbook, https://ww2.arb.ca.gov/resources/documents/woodburning-handbook.

[4] Oregon Dept. of Envtl. Quality, Tips for Cleaners Wood Stove Burning, https://www.oregon.gov/deq/Residential/Pages/Tips.aspx ("Properly installed, correctly used wood-burning appliances should be smoke free.").

[5] U.S. Dept. of Energy, Wood and Pellet Heating, https://www.energy.gov/energysaver/heat-and-cool/home-heating-systems/wood-and-pellet-heating.

[6] Cal. Air Resources Bd., Wood Burning Handbook, https://ww2.arb.ca.gov/resources/documents/woodburning-handbook.

[7] U.S. EPA, Wood Smoke and Your Health, https://www.epa.gov/burnwise/wood-smoke-and-your-health.

Particulate Matter. Particulate matter is a complex mixture of small, solid particles and liquid droplets found in air. Scientific research conducted over decades has confirmed the many health risks associated with breathing particulate matter.

Most research has focused on the size of particles as an important factor in how they affect health. Particle size (mass median aerodynamic diameter) is measured in microns (μm). Particles under 10 μm are of special concern and are broken down into three categories: (1) PM_{10} – "coarse" particles equal to or less than 10 μm; (2) $PM_{2.5}$ – "fine" particles equal to or less than 2.5 μm; and (3) ultrafine particles, or UFP – particles less than 0.1 μm, or 100 nanometers.

Particles under 10 μm are a health concern because when inhaled, they can pass the nasal defenses and penetrate deep into the lungs, and some can even enter the bloodstream.[8] We know the most about the risks of inhaling particles less than 2.5 μm (30 times smaller than the diameter of the average human hair), which have been the focus of much of the public health research.[9] More than 80 percent of the PM emissions from wood heaters are smaller than 2.5 microns.[10]

Although many people think of respiratory problems as the main health effects of air pollution, it is well-established that exposure to particle pollution affects not only the respiratory system, but the cardiovascular system as well.[11] In fact, the global public health burden of PM is primarily due to its cardiovascular effects, with most premature deaths from $PM_{2.5}$ exposure attributable to cardiovascular disease.[12] As a recent article explained: "Breathing fine particles suspended in the air is harmful for everyone – and can kill those with cardiovascular or respiratory vulnerabilities."[13]

Some studies have found a link between air pollution exposure and COVID-19 disease.[14] EPA has stated: "Wood smoke can irritate your lungs, cause inflammation, affect your immune system, and make you more prone to lung infections, likely including SARS-CoV-2, the virus that cause[s] COVID-19."[15]

The American Heart Association published a scientific statement in November 2020 describing evidence-based strategies for preventing $PM_{2.5}$ health impacts and noting that the "evidence associating fine airborne

---

[8] See U.S. EPA, Particulate Matter Basics, https://www.epa.gov/pm-pollution/particulate-matter-pm-basics; Centers for Disease Control and Prevention (CDC), Particle Pollution, https://www.cdc.gov/air/particulate_matter.html.
[9] Id; U.S. EPA, Integrated Science Assessment for Particulate Matter (2019), available at: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534.
[10] U.S. EPA, Process for Developing Improved Cordwood Test Methods for Wood Heaters at 5 (2016), https://www.epa.gov/sites/production/files/2016-03/documents/discussion_paper_-_process_for_dev_imp_cwtm_030916.pdf.
[11] See generally, CDC, Health Impacts of Fine Particles in Air, https://ephtracking.cdc.gov/showAirHIA.action; Cal. Air Resources Bd., Reduce Your Exposure to Particle Pollution, https://ww2.arb.ca.gov/resources/fact-sheets/reduce-your-exposure-particle-pollution; U.S. EPA, Indoor Particulate Matter, https://www.epa.gov/indoor-air-quality-iaq/indoor-particulate-matter.
[12] A. J. Cohen et al., Estimates and 25-year Trends of the Global Burden of Disease Attributable to Ambient Air Pollution: An Analysis of Data from the Global Burden of Diseases Study 2015, *Lancet,* 389:1907–1918 (2017), https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(17)30505-6/fulltext.
[13] J. Shaw, Air Pollution's Systemic Effects, *Harvard Magazine* (March-April 2020), https://www.harvardmagazine.com/2020/03/right-now-air-pollution-systemic-effects.
[14] See X. Wu, et al., Air Pollution and COVID-19 Mortality in the United States: Strengths and Limitations of an Ecological Regression Analysis, *Science Advances,* 6(45), p.eabd4049 (2020), https://projects.iq.harvard.edu/covid-pm/home ("higher historical $PM_{2.5}$ exposures are positively associated with higher county-level COVID-19 mortality rates"); Stanford Medicine, Why Air Pollution is Linked to Severe Cases of COVID-19 (2020), https://scopeblog.stanford.edu/2020/07/17/why-air-pollution-is-linked-to-severe-cases-of-covid-19/.
[15] U.S. EPA, Wood Smoke and Your Health, https://www.epa.gov/burnwise/wood-smoke-and-your-health.

particulate matter...with heart disease, stroke, chronic obstructive lung disease, lung cancer, and premature birth [has been] determined to be unequivocal."[16]

The American Lung Association has summarized the scientific literature regarding exposure to particulate matter and cardiovascular, respiratory, and cancer effects as follows:

Particulate Matter Health Effects

Short-Term Exposures	Long-Term Exposures
• Premature death from respiratory and cardiovascular causes • Increased hospitalization for cardiovascular and respiratory problems • Increased hospitalization for asthma and increased severity of asthma attacks among children • Increased mortality in infants	• Increased risk of death from cardiovascular disease • Increased risk of heart attacks and strokes • Increased risk of lung cancer • Worsening of chronic obstructive pulmonary disease (COPD) in adults • Slowed lung function growth in children and teenagers • Development of asthma in children • Significant damage to small airways of the lungs • Increased risk of lower birth weight and infant mortality

Source: Amer. Lung Assoc., Particle Pollution (updated 4/20/20), https://www.lung.org/clean-air/outdoors/what-makes-air-unhealthy/particle-pollution.

Studies have also examined the association between exposure to particulate matter and neurological and psychiatric disorders, finding evidence connecting $PM_{2.5}$ exposure to, e.g., dementia, Parkinson's disease, and Alzheimer's disease.[17] In its 2019 Integrated Science Assessment for Particulate Matter, EPA concluded that the evidence supports a "likely to be causal relationship" between long-term $PM_{2.5}$ exposure and both cancer and nervous system effects.[18] A study of 95 million Medicare hospitalization claims, published in 2020, confirmed these associations and found links between PM exposure and other diseases, including kidney

[16] S. Rajagopalan, et al., Personal-Level Protective Actions Against Particulate Matter Air Pollution Exposure: A Scientific Statement From the American Heart Association, *Circulation*, 142:e411–e431 (2020).
[17] See Natl. Acad. of Sciences, Health Risks of Indoor Exposure to Particulate Matter: Workshop Summary at 87 (2016), https://www.ncbi.nlm.nih.gov/books/NBK390376/pdf/Bookshelf_NBK390376.pdf (summarizing remarks of Marc Weisskopf); Amer. Lung Assoc., Particle Pollution (internal citations omitted) (updated 4/20/20), https://www.lung.org/clean-air/outdoors/what-makes-air-unhealthy/particle-pollution.
[18] U.S. EPA, Integrated Science Assessment for Particulate Matter at ES-15 (2019), available at: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534.

failure, urinary tract and blood infections, and fluid and electrolyte disorders.[19] This and other studies find that even short-term exposure to particulate matter can be harmful.[20]

Recent studies have estimated thousands of deaths per year attributable to residential wood burning in the U.S.[21] In promulgating its 2015 rule to tighten PM emissions standards for new residential wood heaters, EPA stated that the "rule will generate substantial health benefits by reducing emissions of $PM_{2.5}$, HAPs [hazardous air pollutants], as well as criteria pollutants and their precursors, including CO [carbon monoxide] and VOC [volatile organic compounds]."[22] The agency estimated that the rule would result in significant monetized public health benefits, in light of associated reductions in mortality, non-fatal heart attacks, hospital admissions, asthma exacerbation and associated emergency room visits, cardiovascular and respiratory symptoms, lost work days, and prevalence of other diseases related to particulate matter.[23]

Other Pollutants in Wood Smoke. Hazardous air pollutants in wood smoke – including benzene, acrolein, formaldehyde, and polycyclic aromatic hydrocarbons – are associated with cancer and respiratory disease.[24] According to EPA, residential wood burning "accounts for 44 percent of total stationary and mobile polycyclic organic matter (POM) emissions, which accounts for nearly 25 percent of all area source air toxics cancer risks and 15 percent of noncancer respiratory effects."[25] Health impacts most commonly associated with exposure to nitrogen dioxide are respiratory in nature.[26] Carbon monoxide – an odorless, colorless gas that can be released during incomplete burning of fuels – can cause headache, dizziness, nausea, and confusion, and acute exposure can lead to death.[27]

People at Greater Risk of Health Effects. Anyone who is exposed to wood smoke is potentially at risk of harm. However, many people are at greater risk:

- Children and teenagers;
- Older adults;
- People with lung disease -- including asthma and COPD;
- People with heart disease;

---

[19] Y. Wei, et al., Short-term Exposure to Fine Particulate Matter and Hospital Admission Risks and Costs in the Medicare Population: Time Stratified, Case Crossover Study, *BMJ*, 367:l6258 (2019), https://www.bmj.com/content/367/bmj.l6258.

[20] See id.; U.S. EPA, Integrated Science Assessment for Particulate Matter at 1-21 (2019), available at: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534.

[21] S. Penn, et al., Estimating State-Specific Contributions to PM2.5- and O3-Related Health Burden from Residential Combustion and Electricity Generating Unit Emissions in the United States, *Environ. Health Perspect.,* 125:324–332 (2017), http://dx.doi.org/10.1289/EHP550 (describing own study findings and those of prior studies).

[22] 80 Fed. Reg. 13671, 13694.

[23] U.S. EPA, Regulatory Impact Analysis (RIA) for Residential Wood Heaters NSPS Revision at Sec. 7, Tables 7.1, 7.3 https://www.epa.gov/sites/production/files/2015-02/documents/20150204-residential-wood-heaters-ria.pdf (estimating total monetized human health benefits to be between $3.4 billion and $7.6 billion under a 3% discount rate annually from 2015 through 2020).

[24] For health effects information on these substances, see CDC/ATSDR, Toxic Substances Portal: ToxFAQs, https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsLanding.aspx.

[25] US. EPA, Regulatory Impact Analysis (RIA) for Residential Wood Heaters NSPS Revision at 1-2, (2015), https://www.epa.gov/sites/production/files/2015-02/documents/20150204-residential-wood-heaters-ria.pdf.

[26] Short term exposure can aggravate asthma and other existing respiratory disease, while long-term exposure can result in chronic bronchitis and COPD. See U.S. EPA, Nitrogen Dioxide (NO2) Pollution, https://www.epa.gov/no2-pollution/basic-information-about-no2#Effects; U.S. EPA, Asthma Triggers: Gain Control, https://www.epa.gov/asthma/asthma-triggers-gain-control.

[27] See U.S. Consumer Product Safety Comm., Carbon Monoxide Questions and Answers, https://www.cpsc.gov/Safety-Education/Safety-Education-Centers/Carbon-Monoxide-Information-Center/Carbon-Monoxide-Questions-and-Answers.

- People with compromised immune systems; and
- People of low socioeconomic status, including those who are without housing and those with limited access to medical care.[28]

Because chronic respiratory conditions such as asthma increase susceptibility to the effects of air pollution, populations with higher prevalence rates of those underlying conditions bear a disproportionate risk. According to a report published in 2020 by the Asthma and Allergy Foundation of America, "Nearly 25 million people in the United States are living with asthma, but prevalence rates differ significantly by race and ethnicity" and "the burden of asthma falls disproportionately on Black, Hispanic and American Indian and Alaska Native populations."[29] As the report also notes, "Research shows that asthma disparities are highly driven by socioenvironmental and economic conditions, and that structural injustices over time have led to accumulated disadvantage for specific racial and ethnic populations in the U.S."[30]

These higher asthma prevalence rates may, in turn, be attributable in part to exposure to air pollution. While there are areas in all parts of the U.S. with elevated levels of outdoor PM, racial/ethnic disparities in air pollution exposure are well documented. According to a 2011 Centers for Disease Control (CDC) analysis, "Minority groups, including Asians and Hispanics, were more likely to reside in [counties where outdoor PM levels exceed national standards] in comparison with non-Hispanic whites."[31] The American Heart Association recently emphasized the importance of addressing health disparities from air pollution exposure: "Reducing exposure to air pollution and reversing the negative impact of poor air quality on heart health through individual, industry and policy measures is essential to drive down disparities in health outcomes."[32]

Wood Burning in the United States

The devices that are the focus of this paper – e.g., wood stoves and fireplaces – account for most of the wood burning inside homes.[33] Some of the approaches discussed in the report may also be relevant to other types of residential solid fuel burning devices.

---

[28] See US. EPA, Wood Smoke and Your Health, https://www.epa.gov/burnwise/wood-smoke-and-your-health; U.S. EPA, Wildfire Smoke: A Guide for Public Health Officials at 9 (rev. 2019), https://www3.epa.gov/airnow/wildfire-smoke/wildfire-smoke-guide-revised-2019.pdf.

[29] Asthma and Allergy Fndn. of America, Asthma Disparities in America: A Roadmap to Reducing Burden on Racial and Ethnic Minorities at 11-12 (2020), available at: www.aafa.org/asthmadisparities ("Decades of extensive research and public health data identified disparities in asthma prevalence, mortality and health care utilization along racial and ethnic lines."). See also CDC, Asthma Visualizations, https://www.cdc.gov/asthma/data-visualizations/default.htm (2016-2018 CDC data show that Blacks, Puerto Ricans, and people of multiple races were more likely than Whites to have asthma); U.S. EPA. Wildfire Smoke: A Guide for Public Health Officials at 9 (2019) ("People of color and impoverished children and adults bear a disproportionate burden of asthma and other respiratory diseases and therefore they may be at increased risk of health effects due to wildfire smoke exposure").

[30] Asthma and Allergy Fndn. of America, Asthma Disparities in America: A Roadmap to Reducing Burden on Racial and Ethnic Minorities at 14 (2020), available at: www.aafa.org/asthmadisparities.

[31] CDC, Fact Sheet: Health Disparities in Unhealthy Air Quality (2011), https://www.cdc.gov/minorityhealth/chdir/2011/factsheets/AirQuality.pdf.

[32] Amer. Heart Assoc., Personal Protection and Public Policy Change can Decrease Health Impact of Air Pollution (Nov. 2020), https://newsroom.heart.org/news/personal-protection-and-public-policy-change-can-decrease-health-impact-of-air-pollution.

[33] See U.S. EPA, Regulatory Impact Analysis (RIA) for Proposed Residential Wood Heaters NSPS Revision (2014), https://www.epa.gov/sites/production/files/2020-07/documents/wood-heaters_ria_proposed-nsps-revision_2014-01.pdf (noting that wood stoves, pellet stoves, and fireplaces made up 95% of residential wood heater shipments in 2008).

Indoor Residential Wood-Burning Devices

Traditional masonry fireplaces are the least efficient at heating a room and do not burn as cleanly as a wood stove. They can be retrofitted with an EPA-certified wood stove insert (similar in design to a wood stove, but installed within the existing fireplace) to reduce emissions.

Wood stoves, which vary in their design, efficiency, and emissions, are usually built of cast iron and designed to burn logs (cordwood). As discussed in Part Two, EPA rules set emissions limits and certification requirements for newly manufactured wood stoves and other wood heaters.

Pellet stoves are considered to have lower emissions than wood stoves that use cordwood, in part because they allow less variability in the type and amount of fuel used. Compressed pellets (composed of ground, dried wood and other biomass wastes) are poured into a hopper, which feeds automatically into the stove.

Masonry heaters are also considered generally more efficient and less polluting than wood stoves. Heat from a rapidly burning fire within the masonry structure is slowly released into the home.

Sources: U.S. EPA, Types of Wood-Burning Appliances, https://www.epa.gov/burnwise/types-wood-burning-appliances#fireplace%20inserts; U.S. Dept. of Energy, Wood and Pellet Heating, https://www.energy.gov/energysaver/heat-and-cool/home-heating-systems/wood-and-pellet-heating; NYSERDA, New York State Wood Heat Report at 153-156 (2016), https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/15-26-NYS-Wood-Heat-Report.pdf.

Extent of Wood Burning Across the United States. Residential wood burning has become increasingly popular in recent years. The federal Energy Information Administration (EIA) estimated that for winter 2020-21, approximately 1.8 million U.S. homes would use wood as their primary heat source, and around 10 million additional homes would use wood for at least some of their energy needs, making wood the second-most common supplemental heat source after electricity.[34] The EIA has found that "stoves are the most common equipment used by households that rely on wood as the main source of heat, and fireplaces are the most common choice for secondary wood heating."[35]

The rate of wood burning varies in different regions of the country. Almost one third of U.S. residential wood consumption in 2015 occurred in the Northeast, where the rate of wood burning was 50 percent higher than

[34] U.S. Energy Information Admin., Short-Term Energy Outlook (March 2021), https://www.eia.gov/outlooks/steo/report/winterfuels.php#:~:text=Wood,as%20a%20supplemental%20heating%20fuel

[35] U.S. Energy Information Admin., Increase in Wood as Main Source of Household Heating Most Notable in the Northeast (2014), https://www.eia.gov/todayinenergy/detail.php?id=15431.

the U.S. average. While the nation saw a five percent increase in the number of households burning wood from 2010-2017, the Northeast saw a 21 percent increase.[36]

In general, rural homes are more likely to use wood stoves and wood-burning furnaces or boilers than urban and suburban homes, and detached single-family homes are more likely to burn wood than those with multiple units.[37] In the Navajo Nation, the largest sovereign Native American Nation within the U.S., as many as 89 percent of rural Navajo homes use wood stoves for heating.[38]

Some energy policies at the federal and other levels of government promote increased use of wood as a renewable alternative to fossil fuels. For example, Vermont's energy plan calls for increasing wood's share of building heating. [39] As EPA notes, however, biomass "is not necessarily a carbon-neutral resource. A determination of carbon neutrality requires an assessment of the particular conditions under which a type of biomass (e.g., feedstock) is grown and consumed."[40] Moreover, as others have pointed out, imperfect combustion in wood-burning devices emits not only PM, but also short-lived climate pollutants, notably black carbon, methane, and volatile organic compounds, a component of ground-level ozone.[41] New York is an example of a state program that promotes wood as a renewable fuel while emphasizing the use of lower-emitting, automated heating devices such as pellet stoves.[42]

---

[36] M. Ahmadi, et al., Investigation of Real-life Operating Patterns of Wood-burning Appliances using Stack Temperature Data, J*. of the Air & Waste Mgmt. Assoc*., 70:4, 393-409 at 393 (2020), https://www.nescaum.org/documents/ahmadi-operating-patterns-wood-burning-appliances-using-stack-temp-data_jawma2020.pdf/.

[37] U.S. Energy Information Admin., Short-Term Energy Outlook (Oct. 2020), https://www.eia.gov/outlooks/steo/report/winterfuels.php#:~:text=Wood,as%20a%20supplemental%20heating%20fuel; Comm. for Envtl. Cooperation, Residential Wood Use Survey to Improve U.S. Black Carbon Emissions Inventory Data for Small-Scale Biomass Combustion at 15, 17, 26 (2019), https://www.nescaum.org/documents/cec-abt-nescaum-residential-wood-survey-final-report-201904.pdf/ (rural homes more likely to use wood stoves and to burn larger quantities of wood).

[38] W.M. Champion, et al., Perception, Culture, and Science: A Framework to Identify In-Home Heating Options to Improve Indoor Air Quality in the Navajo Nation, *Science of the Total Envt.,* 580, 297–306 (2017). https://www.sciencedirect.com/science/article/pii/S0048969716324925?via%3Dihub (also noting that census data showed that wood is the primary heating fuel in 63% of all Navajo homes).

[39] In Vermont, e.g., which has abundant forest resources, the state energy plan calls for increasing wood's share of building heating. See C. Recchia, Comprehensive Energy Plan at 8 (2016), https://outside.vermont.gov/sov/webservices/Shared%20Documents/2016CEP_Final.pdf; A. Sherman et al., Expanded Use of Advanced Wood Heating in Vermont (2018), http://www.revermont.org/wp-content/uploads/FINAL-2030-Wood-Heat-Road-Map.pdf; Vermont Dept. of Forests, Parks and Recreation, Wood Energy, https://fpr.vermont.gov/forest/wood-energy.

[40] U.S. EPA, Renewable Heating and Cooling: Biomass Heating and Cooling Technologies, https://www.epa.gov/rhc/biomass-heating-and-cooling-technologies. See also Clean Heat and The Danish Ecological Council, Residential Wood Burning: Environmental Impact and Sustainable Solutions at 4 (2016), https://www.clean-heat.eu/en/actions/info-material/download/background-paper-residential-wood-burning-3.html (climate impact of wood burning depends on a variety of factors, including type of trees felled, rate of forest re-growth, and amount of energy used to process and transport the wood).

[41] Clean Heat and The Danish Ecological Council, Residential Wood Burning: Environmental Impact and Sustainable Solutions at 4 (2016), https://www.clean-heat.eu/en/actions/info-material/download/background-paper-residential-wood-burning-3.html.

[42] New York State Energy Research and Devt. Authority (NYSERDA) issued a detailed report to provide "an analytical framework to guide NYS in expanding the use of wood in heating applications" while also "ensur[ing] public health and environmental protection." NYSERDA, New York State Wood Heat Report: An Energy, Environmental, and Market Assessment at S-1 (2016), https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/15-26-NYS-Wood-Heat-Report.pdf. See also NYSERDA, Renewable Heat NY, https://www.nyserda.ny.gov/All-

Contribution of Wood Burning to Air Pollution. Although wood burning is a small percentage of total residential energy consumption in the U.S., it is responsible for a "disproportionately large share of air pollutant emissions."[43] An analysis of EPA's 2017 National Emissions Inventory (NEI) data showed that wood heating emissions accounted for 98 percent of $PM_{2.5}$ emissions from the residential fuel combustion category. The analysis also found that residential wood combustion emits approximately 340,000 tons of primary $PM_{2.5}$ annually, making it the largest source of *primary* $PM_{2.5}$ after road dust and fires, exceeding primary $PM_{2.5}$ contributions from the highway and off-highway motor vehicle sectors combined.[44]

Wood burning is responsible for a "disproportionately large share" of air pollutant emissions in the U.S.

Wood smoke pollution has caused many areas of the U.S. to either exceed or approach EPA's air quality limits for $PM_{2.5}$, largely in the western region.

- Some of the highest $PM_{2.5}$ concentrations in the nation have been recorded in portions of the Fairbanks North Star Borough nonattainment area in Alaska, where wood smoke contributes up to 60-80 percent of $PM_{2.5}$ emissions.

- In Washington state, wood smoke is the biggest source of $PM_{2.5}$ in the Takoma-Pierce County Smoke Reduction Zone, contributing more than half of the pollution on an average winter day.

- A 2010 study of five western Montana communities showed that "wood smoke (likely residential woodstoves) was the major source of $PM_{2.5}$ in each of the communities, contributing from 56% to 77% of the measured wintertime $PM_{2.5}$."[45]

Residential wood burning's substantial contribution to air pollution is not limited to the western region. According to EPA's 2014 NEI data on the percentage contribution of household wood-burning activities to total state $PM_{2.5}$, nine of the top ten states were located in the Northeast and Midwest.[46] An analysis of the 2017 NEI data by the Northeast States for Coordinated Air Use Management (NESCAUM) showed that residential wood heating contributed 23 percent of the $PM_{2.5}$ emitted annually from all sectors in the Northeast region.[47]

Programs/Programs/Renewable-Heat-NY and Residential Pellet Stove, https://www.nyserda.ny.gov/All-Programs/Programs/Renewable-Heat-NY/Residential-Wood-Pellet-Stove.

[43] M. Ahmadi, et al., Investigation of Real-Life Operating Patterns of Wood-Burning Appliances Using Stack Temperature Data, *J. of the Air & Waste Mgmt. Assoc*., 70:4, 393-409 at 393 (2020), https://www.nescaum.org/documents/ahmadi-operating-patterns-wood-burning-appliances-using-stack-temp-data_jawma2020.pdf/.

[44] Northeast States for Coordinated Air Use Management (NESCAUM), Assessment of EPA's Residential Wood Heater Certification Program at 4-5 (2021), https://www.nescaum.org/documents/nescaum-review-of-epa-rwh-nsps-certification-program-202103.pdf/.

[45] U.S. EPA, News Releases (11/30/2020), https://www.epa.gov/newsreleases/state-alaska-and-fairbanks-north-star-borough-receive-147-million-epa-grant-improve-air; Air Safe Pierce County, Air On the Safe Side: Where our Pollution Comes From, http://www.airsafepiercecounty.org/facts; T. Ward and T. Lange, The Impact of Wood Smoke on Ambient $PM_{2.5}$ in Northern Rocky Mountain Valley Communities, *Envtl. Pollution*, v. 158, Issue 3, 723-729 (2010), https://www.sciencedirect.com/science/article/abs/pii/S0269749109004965?via%3Dihub.

[46] These states included Vermont, Minnesota, New Hampshire, Maine, Connecticut, Michigan, Massachusetts, and Rhode Island. See NESCAUM, State Impact of Residential Wood Combustion, 2014 (presenting NEI data)(on file with ELI). See also U.S. Energy Information Admin., Residential Energy Consumption Survey, Table HC6.7 (rev. 2018), https://www.eia.gov/consumption/residential/data/2015/hc/php/hc6.7.php.

[47] NESCAUM, Comments on Proposed Amendments to Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters, and Forced-Air Furnaces (7/6/20), available at:

Although rural homes are more likely to use wood for heat, wood smoke is an urban problem as well. A 2013 EPA report stated that "fireplaces may represent as much as 75 percent of the pollution from wood-burning devices on bad air quality days in the San Francisco Bay Area....and may be responsible for 20-25 percent of all sources of $PM_{2.5}$."[48] In Multnomah County, Oregon – home to the city of Portland – wood smoke from home heating accounts for more than half of all fine particle pollution on an average winter day.[49]

Indoor Exposure to Wood Smoke

Wood smoke affects air quality when smoke leaves chimneys, and policies and programs to reduce wood smoke emissions primarily address the effect of wood burning on ambient (outdoor) air quality. However, *exposure* to wood smoke pollutants takes place largely *inside* buildings. A recent study estimated that 90 percent of total exposure to fine particulate matter in the U.S. occurs indoors.[50] This finding is not surprising in light of an earlier study showing that people spend 87 percent of their time in buildings, on average.[51]

While we are exposed to many different pollutants indoors, particulate matter is one of the most significant in terms of health risks. A study by scientists at Lawrence Berkeley National Laboratory modeled the health impacts of non-biological air pollutants in U.S. homes and found that fine particulate matter was responsible for the largest number of lost years of productive life.[52]

Indoor exposure to particulate matter and other pollutants in residential wood smoke occurs in two ways.

- First, people are exposed to wood-burning pollutants that escape the device and are released directly into the home.

- Second, pollutants that are emitted by indoor wood-burning devices through a chimney can re-enter the home – and enter nearby homes – through cracks and gaps in the building envelope, windows, or mechanical ventilation systems. Thus, people who do not burn wood may still be exposed to wood smoke pollutants inside their homes.

An early study estimated that as much as 70 percent of chimney smoke can end up re-entering the home or entering other homes.[53] Although new buildings can be constructed to provide good protection from outdoor air pollution, existing homes vary widely in the level of protection they provide. In general, buildings with

---

https://www.nescaum.org/documents/proposed-rule-to-allow-continued-sales-of-step-1-residential-wood-burning-devices-after-may-15-2020-prohibition/. See also NYSERDA, New York State Wood Heat Report: An Energy, Environmental, and Market Assessment at 31 (2016), https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/15-26-NYS-Wood-Heat-Report.pdf ("While the overall use of wood for heating purposes is minimal compared to other fuels...its impact on NYS' air quality is significant").

[48] U.S. EPA, Strategies for Reducing Residential Wood Smoke at 11 (2013), https://www.epa.gov/sites/production/files/documents/strategies.pdf.

[49] Multnomah County (OR), Learn About Wood Smoke Pollution, https://multco.us/health/staying-healthy/learn-about-wood-smoke-pollution.

[50] P. Azimi & B. Stephens, A Framework for Estimating the U.S. Mortality Burden of Fine Particulate Matter Exposure Attributable to Indoor and Outdoor Microenvironments, *J. Expo. Sci. Environ. Epidemiol*., 30, 271–284, Table 2 (12/05/18), https://www.nature.com/articles/s41370-018-0103-4.

[51] N. Klepeis, The National Human Activity Pattern Survey (NHAPS): A Resource for Assessing Exposure to Environmental Pollutants (2001), https://indoor.lbl.gov/sites/all/files/lbnl-47713.pdf.

[52] J. Logue, et al., A Method to Estimate the Chronic Health Impact of Air Pollutants in U.S. Residences, *Envtl. Health Persp*., v. 120, no. 2 at 216 (2012), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3279453/.

[53] W.E. Pierson et al., Potential Adverse Health Effects of Wood Smoke (1989), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1026893/.

envelopes and mechanical systems that are leaky or poorly maintained will provide less protection from outdoor particulate matter.[54]

Although most of the research on wood smoke pollution focuses on ambient air, some recent studies have found high levels of particulate matter and other wood smoke constituents inside homes that use wood-burning devices. For example, a 2015 study of 96 homes using wood stoves in the northwestern U.S. and Alaska found "average indoor $PM_{2.5}$ concentrations exceeding [World Health Organization] ambient air quality guidelines and approaching the US EPA 24-hour standard...."[55] A 2020 study of 137 homes in New England found higher concentrations of indoor air combustion-related pollutants in homes using wood stoves – modestly higher $PM_{2.5}$ levels and more pronounced increases in black carbon and elemental carbon levels.[56]

Technical Approaches to Reducing Emissions from Wood-Burning Devices

This report focuses on space heating devices used indoors, such as wood stoves and fireplaces, which make up a large fraction of residential wood burning. Many of the technical approaches to reducing emissions from these devices can be grouped into two general categories: (1) switching to a different device; and (2) using proper wood-burning practices.

Switching the Heating Device. One approach that has been incorporated into policies and programs is replacing an existing wood-burning heater with a less polluting device.

Many current policies require or incentivize replacing older wood heaters with a new, certified model. A common assumption underlying these efforts is that new EPA-certified wood heaters will produce a substantial decrease in $PM_{2.5}$ emissions. Wood stove performance and emissions in a home are, however, affected by the highly variable nature of the wood burned and by the reliance on user controls – e.g., when filling the stove and adjusting device settings.[57] And, as discussed in Part Two, the testing methods currently required to certify new wood heater emissions may not reflect the conditions of actual use – the devices may emit more pollutants when used in the home than when tested in the lab.

[54] See Natl. Acad. of Sciences, Health Risks of Indoor Exposure to Particulate Matter: Workshop Summary at 73 (2016), https://www.ncbi.nlm.nih.gov/books/NBK390376/pdf/Bookshelf_NBK390376.pdf.

[55] E. Semmens, et al., Indoor Particulate Matter in Rural, Wood Stove Heated Homes, *Environ Res*., 138: 93–100 (Apr. 2015), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4385435/#__ffn_sectitle (noting also that "household income was inversely associated with $PM_{2.5}$ and smaller size fraction" particle number concentrations). *See also* Or. Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 12 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf (internal citations omitted) (describing studies of pollutant levels in wood-burning homes in Sweden).

[56] A. Fleisch, et al., Residential wood stove use and indoor exposure to $PM_{2.5}$ and its components in Northern New England, *J. Expo. Sci. Environ. Epidemiol.,* 30: 350-361 (2020), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6934936/ (increased levels higher with use of older stoves, non-EPA-certified stoves, and wet or mixed wood).

[57] See U.S. EPA, Process for Developing Improved Cordwood Test Methods for Wood Heaters at 13-14 (2016), https://www.epa.gov/sites/production/files/2016-03/documents/discussion_paper_-_process_for_dev_imp_cwtm_030916.pdf.

A number of studies of air pollutant levels *within* the home following replacement with new wood heaters found that air quality improved in some, but not all homes.[58]

Given these uncertainties, rather than center policies around new wood-burning devices that require optimal operation and maintenance to achieve reduced emissions, some jurisdictions have chosen to require or encourage replacing cordwood heaters with pellet stoves (which involve less variability) or with devices that use other fuels, such as electric heat pumps. Gas heating appliances are another option incorporated in some policies, though not all households have access to gas service. Some local jurisdictions in the U.S. have adopted policies prohibiting or discouraging gas appliances in new homes, in an effort to address both indoor pollutant emissions (e.g., from gas stoves) and the goal of reducing use of fossil fuels.[59]

Many policies require or incentivize a switch to lower-emitting devices, including non-wood alternatives.

Using Proper Wood-Burning Practices. The California Air Resources Board advises: "To be a good neighbor, eliminate wood burning. If you do burn, learn to limit the amount of wood smoke produced."[60]

As a starting point, a cordwood- or pellet-burning appliance should be properly sized for the space to be heated, since a device that is too big is more likely to burn at a low smolder and emit more pollutants.[61] The way in which a cordwood stove is operated has a major impact on its emissions, regardless of when the device was manufactured.

---

[58] See T. Ward, et al., Efficacy of Interventions Targeting Household Air Pollution from Residential Wood Stoves, *J. Expo. Sci. Environ. Epidemiol*., 27, 64–71 (2017), https://doi.org/10.1038/jes.2015.73 (16 homes receiving wood stove changeouts "showed no significant changes in $PM_{2.5}$ or particle counts"); M. Survilo, Indoor Air Quality Impacts of a Woodstove Exchange Program in Washington County, Oregon at 46, 59 (Master's Thesis, Portland State University, Oct. 2020), https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=6656&context=open_access_etds (finding "very little reduction in PM2.5" from wood stove changeouts); R. Allen et al., The Impact of Wood Stove Technology Upgrades on Indoor Residential Air Quality, *Atmospheric Environment*, v. 43, no. 37 (2009), https://www.researchgate.net/publication/223913709_The_impact_of_wood_stove_technology_upgrades_on_indoor_residential_air_quality ("did not find a consistent relationship between stove technology upgrades and indoor air quality improvements in homes where stoves were exchanged"); T. Ward, et al., Lessons Learned from a Woodstove Changeout on the Nez Perce Reservation, *Sci. Total Environ.,* 409(4):664-70 (2011) (IAQ improved in 10 of 16 studied homes following wood stove changeout and education, while 5 homes had increased indoor $PM_{2.5}$ concentrations); C. Noonan, et al., Assessing the Impact of a Wood Stove Replacement Program on Air Quality and Children's Health, Health Effects Inst. Paper Number 162 (Dec. 2011), https://www.healtheffects.org/system/files/Noonan162.pdf (finding decreased indoor PM2.5 concentrations in 16 of 21 studied homes after changeout with substantial variability in the measurements). But see A. Fleisch, et al., Residential Wood Stove Use and Indoor Exposure to $PM_{2.5}$ and its Components in Northern New England, *J. Expo. Sci. Environ. Epidemiol.,* 30: 350-361 (2020), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6934936/ (study found higher pollutant levels in homes using wood stoves, especially with use of older stoves, non-EPA-certified stoves, and wet or mixed wood).

[59] *See* Rocky Mountain Inst., All-Electric New Homes: A Win for the Climate and Economy (Oct. 2020), https://rmi.org/all-electric-new-homes-a-win-for-the-climate-and-the-economy/; Natural Resources Defense Council, The Pathway to New All-Electric Low Income Housing in CA (2020), https://www.nrdc.org/experts/merrian-borgeson/pathway-new-all-electric-low-income-housing-ca; Sierra Club CA Comments on 2022 Energy Code Workshop on November 3, 2020, TN 235658, (docketed Nov. 18, 2020), available at: https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=19-BSTD-03.

[60] Cal. Air Resources Bd., Wood Burning Handbook, https://ww2.arb.ca.gov/resources/documents/woodburning-handbook.

[61] U.S. Dept. of Energy, Wood and Pellet Heating, https://www.energy.gov/energysaver/heat-and-cool/home-heating-systems/wood-and-pellet-heating.

Key operating practices include:[62]

- Using the right fuel. Wood should be dry (moisture content under 20 percent) and seasoned (at least six months). It should be split, stacked, and stored outdoors (covered and off the ground). Fires should be started with natural fire starters, such as dry kindling or newspapers – and wood burning appliances should never burn trash, coated/painted/pressure-treated wood, plywood, plastic, asbestos, rubber, manure, or animal remains.

- Building and maintaining the fire properly. While the fire is burning, proper operation includes monitoring the temperature of the fire and the position of the damper. Fires should be built small and hot, rather than smoldering at a lower temperature, with the damper open. The doors should be closed (except when loading or stoking a fire) to control airflow and minimize the escape of pollutants into the home. Lighting and refueling should be done quickly and carefully, as these are the times when the most smoke is produced.

Regular inspections by a professional are recommended, preferably prior to each heating season.[63]

Using Air Filters to Reduce Indoor Exposure to Wood Smoke

This report focuses on policies for reducing exposure to wood smoke by reducing *emissions*. It does not discuss another approach that addresses indoor *exposure* alone: the use of high-efficiency filtration to filter air pollutants within the home. This can be done using in-duct filters or portable air cleaners (also called air purifiers). Research has shown that using high-efficiency in-duct filters or using the proper size and type of portable air cleaner can substantially reduce levels of particulate matter within a home. Research has also shown their effectiveness in reducing particulate matter produced by wood burning in homes.

Choosing an air cleaner that will function well in a particular home can be confusing. In 2018, EPA published a guide that provides tips for selecting and using an air cleaner. The guide emphasizes the importance of avoiding portable air cleaners (and furnace/HVAC filters) that intentionally produce ozone and also notes the importance of regular filter replacement.

A 2020 ELI report discussed policies and programs for advancing high-efficiency filtration to reduce PM exposure in new and existing homes.

Sources: U.S. EPA, Residential Air Cleaners, https://www.epa.gov/indoor-air-quality-iaq/air-cleaners-and-air-filters-home; Cal. Air Resources Bd., Air Cleaning Devices for the Home, https://ww2.arb.ca.gov/resources/fact-sheets/air-cleaning-devices-home; T. Ward, et al., Efficacy of Interventions Targeting Household Air Pollution from Residential Wood Stoves*, J .Expo. Sci. Environ. Epidemiol*. 27, 64–71 (2015), https://doi.org/10.1038/jes.2015.73; J. Hart, et. al, Evaluating the Effectiveness of a Commercial Portable Air Purifier in Homes with Wood Burning Stoves: A Preliminary Study, J*. of Entl. and P. Health*, v. 2011, Art. id. 324809 (2008), https://doi.org/10.1155/2011/324809.

[62] See U.S. EPA, Best Wood-Burning Practices, https://www.epa.gov/burnwise/best-wood-burning-practices; Cal. Air Resources Bd., Wood Burning Handbook, https://ww2.arb.ca.gov/resources/documents/woodburning-handbook.
[63] See U.S. Dept. of Energy, Wood and Pellet Heating, https://www.energy.gov/energysaver/heat-and-cool/home-heating-systems/wood-and-pellet-heating.

The Need for Public Policies to Reduce Wood Smoke Emissions and Improve Public Health

Environmental protection and public health are core areas of state, local, and tribal authority that can be marshalled to address pollutant emissions from wood-burning devices. The Tenth Amendment to the U.S. Constitution confirms states' general "police powers" to protect health, safety, and welfare and reserves to the states all powers not delegated to the federal government or specifically prohibited to the states. State law, in turn, establishes the scope of authority for local policymaking within the state. Tribes, as sovereign nations, have broad authority to address air quality and public health issues on their lands.[64]

In general, states, localities, and tribes may adopt and enforce their own laws to reduce wood smoke emissions, independent of federal laws and regulations, provided those measures are at least as stringent as any existing federal requirements.[65] Most state and local policies that address wood burning are established as ambient air quality laws and regulations. According to the federal Clean Air Act, the nation's principal legal framework for protecting air quality, states and political subdivisions have authority to establish a "standard or limitation respecting emissions of air pollutants or...requirement respecting control or abatement of air pollution" from non-mobile sources.[66] The Act authorizes EPA to treat tribes in the same manner as states in implementing the Act, and the agency's Tribal Authority Rule establishes the framework for tribes to submit their implementation programs for EPA approval.[67]

Key Federal Laws and Regulations. The Clean Air Act and its implementing regulations, which are issued by EPA, provide important context for state, local, and tribal policymaking on the issue of wood burning.

National Ambient Air Quality Standards (NAAQS). EPA sets primary (public health) and secondary (public welfare) NAAQS for certain pollutants, including particulate matter.[68] The primary standards must be set at levels which, "allowing an adequate margin of safety, are requisite to protect the public health."[69] The current 24-hour average primary standard for $PM_{2.5}$ is 35 µg/m^3 (annual mean standard is 12 µg/m^3); the 24-hour standard for PM_{10} is 150 µg/m^3.[70] The World Health Organization (WHO) has adopted lower guideline

[64] See generally, Natl. Congress of American Indians, Tribal Governance, https://www.ncai.org/policy-issues/tribal-governance; A. Hoss, A Framework for Tribal Public Health Law, *Nev. L. J.*, v. 20:1 at 119 (2019), https://scholars.law.unlv.edu/cgi/viewcontent.cgi?article=1803&context=nlj ("Tribal sovereignty includes an inherent authority, or a "plenary and exclusive power over their members and their territory subject only to limitations imposed by federal law.") (internal citations omitted).

[65] As noted earlier, state laws may constrain local regulation. Some states have laws that restrict state agencies from adopting requirements that are more stringent than federal environmental requirements. Missouri is an example of a state with a law restricting adoption of wood-burning regulations specifically. Mo. Stat. §643.055.

[66] 42 U.S. Code § 7416.

[67] 42 U.S. Code § 7601(d); 40 CFR Pt. 49.

[68] 42 U.S.C. § 7409. EPA has set NAAQS for $PM_{2.5}$ and PM_{10}, along with five other "criteria" pollutants (carbon monoxide, nitrogen dioxide, lead, ozone, and sulfur dioxide) that cause adverse health effects.

[69] 42 U.S.C. § 7409(b).

[70] See U.S. EPA, NAAQS Table, https://www.epa.gov/criteria-air-pollutants/naaqs-table. In late 2020, EPA concluded its regular review of the PM standard by deciding to leave the current standard in place. U.S. EPA, Natl. Ambient Air Quality Standards (NAAQS) for PM, https://www.epa.gov/pm-pollution/national-ambient-air-quality-standards-naaqs-pm.

values for both $PM_{2.5}$ (25 µg/m^3 24-hour mean and 10 µg/m^3 annual mean) and PM_{10} (50 µg/m^3 24-hour mean).[71]

The Clean Air Act requires measurement of particulate matter and other regulated pollutants through a network of monitors around the country.[72] Based on data from these monitors, states with areas (e.g., counties) 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 with the NAAQS, as part of their State Implementation Plan (SIP).[73] Failure to develop and implement an approved SIP and make progress toward meeting federal air quality standards carries with it significant consequences, including withholding of "all or part of the grants for support of air pollution planning and control programs" that EPA may award to states under the Act.[74]

Tribes may (but are not required to) develop an implementation plan for areas on tribal lands violating federal air quality standards. Like SIPs, Tribal Implementation Plans (TIPs) include enforceable rules and policies for meeting air quality standards, and EPA maintains an ongoing oversight role.[75]

Federal Air Rules for Reservations (FARR). EPA's FARR sets forth a series of air quality rules (including some relating to wood burning) that apply to federally recognized reservations in Idaho, Washington, and Oregon.[76] These rules are made applicable to individual tribes through a Federal Implementation Plan adopted by EPA for each tribe.[77] Tribes may be delegated authority to implement (but not enforce) these federal provisions through delegation agreements with EPA, and a number of tribes have received partial delegation of administrative authority.[78]

New Source Performance Standards (NSPS). EPA establishes NSPS rules under the Clean Air Act for new stationary sources that contribute significantly to air pollution.[79] The NSPS rule for new residential wood heaters, described in Part Two, applies nationwide and is a reference point for state, local, and tribal policies.

Many of the most stringent policies governing wood-burning devices have been adopted for PM nonattainment areas, where enhanced air pollution control measures are required under the Clean Air Act. As a 2016 report by the Oregon Department of Environmental Quality stated: "Being declared in

---

[71] World Health Org., WHO Air Quality Guidelines for Particulate Matter, Ozone, Nitrogen Dioxide and Sulfur Dioxide at 10 (2005), available at: https://apps.who.int/iris/bitstream/handle/10665/69477/WHO_SDE_PHE_OEH_06.02_eng.pdf?sequence=1.

[72] For information about EPA's monitoring network, see U.S. EPA, Ambient Monitoring Technology Information Center, https://www.epa.gov/amtic/amtic-ambient-air-monitoring-networks. Ultrafine particles, a component of wood smoke, are not subject to federal monitoring or regulation.

[73] 40 CFR Pt. 51. See also U.S. EPA, Basic Information about Air Quality SIPs, https://www.epa.gov/sips/basic-information-air-quality-sips (SIPs are a "a collection of regulations and documents used by a state, territory, or local air district to reduce air pollution in areas that do not meet" federal air quality standards).

[74] 42 U.S. Code § 7509(a)(4). EPA develops a Federal Implementation Plan (FIP) when a state fails to submit a SIP or submits a SIP that does not comply with federal law and regulations. U.S. EPA, Basic Information about Air Quality FIPs, https://www.epa.gov/air-quality-implementation-plans/basic-information-about-air-quality-fips.

[75] 42 U.S. Code §§ 7601(d), 7410(o). See also U.S. EPA, Basic Information About Air Quality TIPs, https://www.epa.gov/air-quality-implementation-plans/basic-information-about-air-quality-tips.

[76] 40 CFR 49.121 - 49.139; U.S. EPA, About the Federal Air Rules for Reservations (FARR), https://www.epa.gov/farr/about-federal-air-rules-reservations-farr.

[77] 40 CFR Pt. 49, Subpt. M.

[78] See, e.g., 71 Fed. Reg. 60852 (Confederated Tribes of the Umatilla Indian Reservation); 81 Fed. Reg. 12825 (Confederated Tribes of the Colville Reservation); 70 Fed. Reg. 54638 (Nez Perce Tribe); 73 Fed. Reg. 61742 (Coeur D'Alene Reservation).

[79] 42 U.S.C. § 7411(b)(1)(B).

nonattainment of federal air quality standards is very serious for any community. It means that not only is the air unhealthy, but also that legal requirements are triggered for states to reduce pollution and meet standards; stricter requirements may be imposed on new and potentially existing industry; and the stigma of "nonattainment" can be a deterrent to attracting new business. Communities declared "nonattainment" face serious public health and economic burdens."[80]

Many Jurisdictions can Benefit from Stronger Policies to Reduce Wood-Burning Emissions**.** The examples described throughout this report are possible models not only for nonattainment areas, but for many more jurisdictions throughout the country. Areas currently in attainment should also consider measures to reduce emissions from residential wood burning, for several reasons.

Health Effects Occur Below Federal PM Standards. Even if areas are in attainment with current air quality standards, exposure to particulate matter at levels below current EPA standards can also produce health effects; research has not identified a threshold value below which $PM_{2.5}$ does not affect health.[81] The 2020 study of Medicare hospitalization claims found that health effect "associations remained even at a daily $PM_{2.5}$ concentration below the [World Health Organization] 24 hour guideline," which is lower than the current EPA standard.[82]

Federal Air Monitors May Not Detect Local Wood Smoke Pollution. Even areas determined to be in attainment with federal air quality standards may have pollution "hot spots" that exceed those standards, but are not detected by the network of air monitors established under the Clean Air Act. In particular, those regulatory air monitors may not exist in less densely populated areas, including rural areas where wood heating is more common.[83]

Air monitoring beyond the federal regulatory network can help communities identify and take action to address wood smoke pollution problems. EPA Region 1 has developed a GIS tool using mobile air monitoring

---

[80] Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 13 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf.

[81] See, e.g., U.S. EPA, Integrated Science Assessment for Particulate Matter at ES-23 (2019), available at: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534; F. Dominici, et al., (Health Effects Inst.), Assessing Adverse Health Effects of Long-Term Exposure to Low Levels of Ambient Air Pollution: Phase 1 at 24 (Nov. 2019), https://www.healtheffects.org/system/files/dominici-rr-200-report.pdf; WHO, Air Pollution, https://bit.ly/2pxYITb; Amer. Lung Assoc.,Year-Round Particle Pollution, https://www.lung.org/our-initiatives/healthy-air/sota/key-findings/year-round-particle-pollution.html.

[82] Y. Wei, et al., Short-term Exposure to Fine Particulate Matter and Hospital Admission Risks and Costs in the Medicare Population: Time Stratified, Case Crossover Study, *BMJ*, 367:I6258 (2019), https://www.bmj.com/content/367/bmj.l6258.

[83] See NYSERDA, New York State Wood Heat Report: An Energy, Environmental, and Market Assessment at 387 (2016), https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/15-26-NYS-Wood-Heat-Report.pdf (wood smoke emissions generally "will not be noticed in statewide air monitoring emissions or the regional airshed, as dispersion is local and not likely to impact regional air quality monitors"); M. Brauer, et al., Modeling Pollution from Residential Wood Combustion at 3 (2010), https://www.nescaum.org/documents/modeling-pollution-from-residential-wood-combustion/em-201005-woodsmoke-modeling.pdf (residential wood combustion "is usually not well-characterized by regulatory monitoring networks"); NESCUAM, Assessment of EPA's Residential Wood Heater Certification Program at xiii, 7-8 (2021), https://www.nescaum.org/documents/nescaum-review-of-epa-rwh-nsps-certification-program-202103.pdf/ (residential wood burning "can cause high ambient PM2.5 levels in some locations, even in states that do not have designated PM2.5 non-attainment areas); Natl. Science and Technology Council, Air Quality Observation Systems in the United States at 45 (2013), https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/NSTC/air_quality_obs_2013.pdf ("EPA's primary NAAQS, which are set to protect public health, have led to an urban focus in monitoring these species.").

data in valley areas in New England where there is a "sparse air-monitoring network."[84] In addition, the increasing availability of low-cost air monitors has facilitated community-level air pollution monitoring that can inform policies and programs.[85] EPA has funded work in this area, including a 2016 grant to the University of Washington to develop low-cost sensors to help reduce wood smoke exposures within the Yakama Nation and among Latino communities in rural areas of the state.[86]

Attainment Status Is Subject to Change. There are areas in the U.S. that have $PM_{2.5}$ levels that are elevated but not in violation of current Clean Air Act standards. Taking action now can help avoid exceeding current federal limits in the future. And if EPA lowers the $PM_{2.5}$ standard in future rulemakings, these areas may be required to develop State Implementation Plans with more stringent rules for wood burning.[87] Implementing wood-burning restrictions is a lengthy process; jurisdictions can benefit from laying the groundwork now.

> ***Even areas in compliance with federal air standards can benefit from wood burning policies "to address hotspots and... populations at risk in any neighborhood."***

In developing recommendations for addressing wood burning in Oregon, the state Department of Environmental Quality focused priority recommendations on communities facing nonattainment designation, but also included "other strategies that can provide statewide benefits regardless of whether the community is at risk of meeting the federal health standard or not. It also provides a way to address hotspots and...populations at risk in any neighborhood in Oregon, with the added co-benefit of reducing air toxics emissions from woodsmoke."[88]

Policy Strategies Discussed in this Report

This report describes a variety of policies already in place that provide potential models for jurisdictions considering how best to address the air quality impacts and public health risks associated with indoor wood-burning devices such as wood stoves and fireplaces. Although the focus is on wood, many of the policies reviewed apply to devices that burn solid fuels more generally, including coal. Wood-burning devices not discussed here include forced-air furnaces, indoor and outdoor hydronic heaters (wood boilers), and outdoor fire pits. Controlling emissions from those devices raises overlapping, yet distinct, policy considerations. Also outside the scope of this report is regulation of non-residential wood-burning devices, such as industrial, commercial, and institutional (ICI) boilers.

---

[84] U.S. EPA Reg. 1, Valley Identification Tool – Abstract (1), https://www.arcgis.com/apps/webappviewer/index.html?id=646ebe715800410d9e5c02aa3653546d (accessed 3/15/21).

[85] See generally, Cal. Air Resources Bd., Existing Community Monitoring Systems, https://ww2.arb.ca.gov/capp-resource-center/community-air-monitoring/existing-community-monitoring-systems. See also, Puget Sound Clean Air Agency, Air Quality Sensors, https://www.pscleanair.gov/539/Air-Quality-Sensors (air sensor loan program with priority categories that include households that burn wood a primary heat source).

[86] U.S. EPA, EPA Awards $750,000 STAR Grant to University of Washington for Next-Generation Air Pollution Research, https://19january2017snapshot.epa.gov/newsreleases/epa-awards-750000-star-grant-university-washington-next-generation-air-pollution_.html.

[87] The Clean Air Act requires EPA to reevaluate the NAAQS every five years. 42 U.S.C. § 7409(d)(l). EPA completed its most recent review of the PM standards in December 2020, deciding not to change the existing standard. U.S. EPA, National Ambient Air Quality Standard for PM, https://www.epa.gov/pm-pollution/national-ambient-air-quality-standards-naaqs-pm.

[88] Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at i (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf.

Existing policies for addressing emissions from indoor wood-burning devices advance *two general goals***.**

- Speeding the transition to lower-emitting heating devices or appliances. One component of this transition is ensuring that new wood heaters purchased and installed today meet strict emissions standards. But because wood stoves can last for generations, another key component of this strategy is speeding the removal of existing, older wood-burning devices. Policymakers have established a number of approaches to accelerate the transition to lower-emitting devices – both to newer cordwood and pellet heaters and to non-wood alternatives.

- Changing when and how wood-burning devices are used. A common approach to wood smoke pollution is to restrict or prohibit wood burning when meteorological conditions exacerbate air pollution problems. In addition, many policies address *how* wood-burning devices are operated and maintained to help ensure that the devices – even newer wood stoves – do not impact air quality and public health. These types of measures may be established only for areas with known air quality problems or throughout a jurisdiction.

Part Two describes the central elements of *ten policy strategies* for achieving these goals, ranging from regulatory requirements to financial assistance.

Establishing Emissions and Certification Standards for New Devices. EPA recently tightened its emissions standards for new wood heaters sold in the U.S. While the new standards represent notable progress, questions remain about whether the current certification testing procedures are designed and implemented to reflect emissions in real-world circumstances. Many jurisdictions have incorporated the federal standards into their own laws, while a few have established emissions or certification requirements that are more stringent. These standards are important, as they provide a foundation for other policy strategies and elements.

Restricting the Sale or Transfer of Noncompliant Devices. EPA's federal rules govern the sale of new wood heaters, and some states and localities go further in establishing requirements for the sale or transfer of new and used devices. A number of jurisdictions have taken advantage of another important opportunity for retiring older and more polluting devices, by prohibiting the transfer of noncompliant devices as part of a real estate transaction.

Restricting the Installation of Wood-Burning Devices in Existing and New Homes. Many policies restrict new installations of wood heaters and fireplaces in some fashion. Like transfer restrictions, this approach does not affect the use of existing devices by their current owners, but it can help ensure that homes will not add devices other than those expressly allowed in the policy. By restricting new installations, jurisdictions can help prevent an increase in emissions and avoid the need to regulate use of the additional devices in the future.

Prohibiting the Use of Noncompliant Wood-Burning Devices Generally. Rather than wait for a home to be sold to require removal of noncompliant devices, a stronger measure would be to prohibit the use of such devices by their current owners. A small number of jurisdictions facing serious air pollution problems have banned the use (and/or required the removal) of certain noncompliant wood heaters in existing homes.

Restricting the Use of Wood-Burning Devices during Periods of Poor Air Quality. One common approach to reducing emissions from existing devices is to restrict wood burning during periods when air pollution is determined or projected to be elevated. These "curtailment" programs – in effect for many areas that have

experienced high PM levels – require agencies to identify when air quality is impaired, notify the public and initiate a curtailment period, and oversee restrictions on the use of wood-burning devices during that period.

Implementing Performance Standards for Wood Smoke. In addition to regulating the transfer, installation, and use of wood-burning devices, policies can regulate wood burning by establishing performance standards that apply to the smoke being released from a chimney. Many jurisdictions have adopted *opacity* limits for wood smoke, and some have set limits on *visible emissions*. Such standards can help determine compliance with other policy measures, such as curtailment periods or requirements to properly operate and maintain devices. They can also be an important tool for addressing the health risks to people who may be directly affected by smoke from a neighboring chimney.

Establishing Operating Requirements. In addition to whether and when a wood-burning device may be used, *how* the device is used is a key factor in reducing wood smoke emissions, especially for devices that involve greater variability in the amount and type of fuel that is supplied. It is common for wood-burning policies to address general operating practices and to specify what materials may be burned. Such requirements can help support agency action in cases involving excessive wood smoke emissions.

Requiring Information and Education about Wood Burning. Awareness of the health effects of exposure to wood smoke and knowledge of best practices for using wood-burning devices are critical to reducing emissions and complying with regulations. Many jurisdictions throughout the U.S. disseminate information about wood burning, and some localities with severe wood smoke pollution problems have extensive education programs. Some policies require such information to be provided during key commercial transactions: residential real property transfers, device sales and installations, and wood sales.

Providing Financial Assistance for Reducing Emissions. Financial assistance is important as a stand-alone measure and as a complement to regulatory policies that restrict or prohibit use of noncompliant wood heaters, for households that otherwise would have difficulty complying. The report describes two related policy strategies: (1) developing funding programs that are designed exclusively to address wood-burning devices, and (2) leveraging existing government programs that fund a broader set of related activities. Other programs not discussed here – e.g., private sector and utility initiatives – are also important components of a funding strategy. Coordination among programs is important for maximizing resources to reduce wood smoke emissions and lower heating costs for families.

For each of these strategies, the report highlights key policy elements illustrated by examples of laws, regulations, or programs currently in effect. Many of the examples highlighted here have been adopted at the state or local level, while a few are tribal policies and several have been established by regional air quality agencies. The report uses the term “jurisdiction” when referring generally to policies that might be established by states, localities, regional entities, or tribes.

The report does not provide an exhaustive listing or description of policy approaches or of existing policies, and it does not discuss how effectively policies have been implemented. Citations to policies are provided throughout, and a list of the main policies discussed in the report is included in the Appendix.

Considerations for Developing and Implementing Policies

There is no one-size-fits-all strategy for addressing emissions from wood-burning devices. Policy approaches exist on a spectrum, from traditional regulation to education and financial incentives. The measures that are appropriate for a particular community turn on a host of factors, including the scope of the wood smoke pollution problem; the characteristics and history of the community; and the level of access to affordable,

lower-emitting heating devices. Decisions about how to address wood smoke pollution are also closely connected to a jurisdiction's broader sustainable energy policies and goals.

This report's review of wood-burning policies and conversations with officials who implement several of the policies described in Part Two point to a number of general considerations that are important for developing successful approaches.

Engage in extensive community outreach during policy development. The history and culture of wood burning is important context for policy development. People have burned wood for centuries and continue to do so, for heating needs and for pleasure. In some communities, fire plays an important role in cultural practices and identity. One consistent message that emerges from jurisdictions with long experience in this area is that to be successful, policy development should include robust community input and collaboration among government agencies and the affected communities.

Some jurisdictions have formed work groups representing diverse community interests to recommend policy strategies. For example, in May 2018, the Fairbanks Air Quality Advisory Group was set up "to identify, evaluate and recommend community-based solutions to bring the area into compliance with federal air quality standards for fine particulates ($PM_{2.5}$)," for inclusion in the state SIP for serious nonattainment status; members were "responsible for communicating with their constituencies throughout the process while considering the broad interests of all Fairbanks North Star Borough residents who may be affected by poor air quality and the range of possible solutions."[89] Volunteers filled 33 seats designated to represent a broad cross section of the community. The final report of the Advisory Group ranked a long list of potential strategies and was used in developing policy during the SIP process.

In Oregon, concern about the health and economic effects of wood smoke led to the passage of House Bill 3068 in 2015, directing the state Department of Environmental Quality (DEQ) to form a workgroup to develop policy recommendations. The 22-member workgroup held meetings in nine communities around the state to discuss its draft findings and noted the continued need for partnerships between the state and local communities to address wood smoke in a way that is most effective for each community.[90]

In the Navajo Nation, the Diné Policy Institute and other experts developed a framework for evaluating several heating alternatives "that could reduce the negative environmental and health impacts related to solid fuel use while respecting the culture of the Navajo people." They noted that the framework "may be useful for decision makers in communities heavily reliant on solid fuels for heat, especially Native Nations, where culture plays an important role in the success of any intervention."[91]

---

[89] See Fairbanks Air Quality Stakeholders Group, Final Report at 1, 2 (Dec. 2018), https://www.fnsb.gov/DocumentCenter/View/1136/Final-Report-PDF.

[90] See Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at i, 2 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf. The DEQ report noted: "For the most part, densely populated urban areas wanted to take more restrictive actions to mitigate woodsmoke effects while rural areas favored effective solutions ... without compromising their ability to burn wood."

[91] W.M. Champion, et al., Perception, Culture, and Science: A Framework to Identify In-Home Heating Options to Improve Indoor Air Quality in the Navajo Nation, *Science of the Total Envt*., 580, 297–306, 298 (2017), https://www.sciencedirect.com/science/article/pii/S0048969716324925?via%3Dihub. See also K. L. Walters, et al., Growing from Our Roots: Strategies for Developing Culturally Grounded Health Promotion Interventions in American Indian, Alaska Native, and Native Hawaiian Communities, *Prevention Science, 21,*54-64 (2020), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6502697/ (describing five projects, including a residential wood smoke intervention project, that "illustrate the feasibility and process of situating Indigenous health interventions within a research framework guided by original instructions, relational restoration and narrative transformation strategies").

Build on existing policies and institutions. A thorough review of existing policies and programs within a jurisdiction is an important first step in considering how to address wood smoke problems. While new laws or ordinances will be needed for some policy initiatives, jurisdictions may already have laws or regulations in place that can form the basis for developing policies and programs to address emissions from wood-burning devices.

For example, existing building codes can be amended to address the installation of wood-burning devices in new construction. Similarly, programs that provide funding for new affordable housing construction can incorporate restrictions on the installation of wood-burning devices generally or as the sole source of heat. Property transfer disclosure requirements can be revised to include notification of the health effects of wood smoke exposure if wood-burning devices are to be transferred with the property. Existing financial assistance programs for home repairs can be expanded to include replacement of older wood-burning devices. Jurisdictions may be able to develop a more robust wood smoke complaint program based on public nuisance or opacity standards that are already on the books.

Incorporate public education as a policy element. Most people have positive associations with wood burning and with the smell of wood smoke. Although scientific research has firmly established the serious health risks of exposure to particulate matter and other wood-burning pollutants – and the COVID-19 pandemic has recently highlighted the connection between exposure to air pollution and systemic health effects – people who use wood-burning devices may not be aware of these risks, especially the non-respiratory and long-term impacts. They may also not be aware of the wood-burning techniques that are needed to reduce pollutant emissions.

Many federal, state, local, regional, and tribal agencies have used web pages, traditional media, social media, videos, and other tools to provide information, and these resources can assist in the development of programs in other communities. Public education initiatives that provide culturally relevant information about the risks from wood smoke exposure and the proper techniques for using wood-burning devices are important undertakings in themselves – and also a key component of any policy regulating wood burning. Health care providers and payers are another potentially important audience for information about wood burning best practices – not only as partners in conveying key messages to patients, but also as stakeholders in policy development.

Policies can be crafted to support and advance agency outreach initiatives, and some jurisdictions have enacted laws or regulations providing funding for or requiring the development of education programs on wood smoke and proper wood-burning techniques.

Identify mechanisms and resources for implementation. The ongoing resources needed by government agencies to ensure compliance is an important consideration when developing regulations to reduce emissions from wood burning. Implementing restrictions on when and how devices are used can be a resource-intensive undertaking. This is partly because wood burning is a highly localized activity, occurring in individual homes over a potentially large area. It also reflects the nature of the activity, which requires education and compliance assistance to facilitate changes in wood-burning practices. Some of the policies described in Part Two include provisions that can support implementation and enforcement – e.g., standards limiting “visible smoke” emissions that can be determined without special training, and requirements for permitting of new installations or registration of existing devices in certain situations.

For many policies enacted at the state level – e.g., burn bans or opacity limits – support for local agency partners is needed for ongoing education and enforcement activities. Enforcement of wood-burning restrictions may require considerable staff resources to make site visits to investigate wood smoke

complaints and/or conduct routine monitoring of burn restrictions. It is important for local jurisdictions to have both authority (an enforceable standard) and capacity (resources and staffing) to address situations where individuals are significantly impacted by nearby wood smoke emissions. As the Oregon DEQ noted in its 2016 legislative report: "Investing in local air programs is the most effective way to address a community's immediate needs for smoke reduction as well as maintain the gains over time to ensure compliance with health standards."[92]

Provide financial assistance to qualified households. Federal data from 2009 show that lower-income households that burn wood consume more wood on average than higher-income households that burn wood.[93] Lower-income households may be more likely to have older wood stoves rather than newer, lower-emitting devices.[94] Replacing older wood stoves with newer models involves a significant upfront cost for the device. And a switch to non-wood heating may involve not only the cost of the device, but higher operating costs as well, since wood is plentiful and inexpensive in many areas. For these reasons, many policies that restrict wood burning allow for waivers in cases of economic hardship. Financial assistance is also critical – both to help households meet regulatory restrictions *and* to reduce their exposure to wood smoke.

States, localities, and tribes across the country have carried out numerous programs that offer financial incentives to replace older wood-burning devices with lower-emitting alternatives. These "changeout" programs, which often combine public, private, and philanthropic funds, are an opportunity to support the cleanest-burning heating devices that are feasible, cost-effective, and consistent with the jurisdiction's energy policy goals. Some programs have targeted their funding to non-wood heating and/or lower-emitting wood-burning devices such as pellet stoves. Given limited resources, programs should prioritize financial assistance to families with limited income – as well as to owners of affordable rental housing – to help families who rely on wood obtain lower-emitting devices and afford the costs of operating the device.

[92] Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 4 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf.
[93] U.S. Energy Information Admin., Increase in wood as main source of household heating most notable in the Northeast, https://www.eia.gov/todayinenergy/detail.php?id=15431.
[94] Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 5 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf.

PART TWO: REVIEW OF CURRENT POLICY STRATEGIES

This part of the report takes a closer look at several policy strategies that address directly the goal of reducing emissions from residential wood-burning devices. The focus is on devices used indoors, such as stoves and fireplaces, though some of the policies described here apply to a larger universe of devices – e.g., wood-burning furnaces, wood boilers, and/or devices that burn other solid fuels, such as coal.

Each of the following five chapters of the report is devoted to one broad area of policymaking:

- Emissions and certification standards;
- Sale, transfer and installation of devices;
- Use of existing devices;
- Information and education; and
- Financial assistance.

These chapters cover a total of ten different policy strategies, focusing on some of the key elements of the laws and regulations currently in place – e.g., the types of devices/fuels that are allowed, any exemptions that are available, and whether the policies are limited to specified areas within the jurisdiction. Many of the policy strategies described here are closely related to one another and are best understood by reading Part Two as a whole.

The report does not provide an exhaustive list of existing policies, but it describes or references dozens of examples from around the country. The Appendix lists in one place the main policies described in the report, along with links to web pages where those policies can be found.

CHAPTER 1
Emissions and Certification Standards for Wood-Burning Devices

Emissions and certification standards for wood-burning devices are a core element of most of the policy strategies described throughout this report.

EPA's emissions and certification requirements govern *new* wood heaters and apply throughout the country. States, localities, and tribes may incorporate the federal standards into their own laws and regulations. They may also establish their own standards, provided the standards are at least as strict as those adopted by EPA. Most policies described here incorporate the federal standards, though at least a few jurisdictions have established more stringent emissions requirements.

This chapter provides background on federal policy and describes how jurisdictions have addressed emissions and certification in their policies:

- EPA's wood heater rule, including the current emissions standards that took effect in May 2020, and recent questions raised by EPA and other parties as to whether federal emissions testing requirements reflect device performance in homes.

- Examples of jurisdictions that have adopted the most recent EPA emissions standards. Such policies are important in part because they may provide authority for the jurisdiction to supplement EPA enforcement of federal requirements for new devices. They are also significant to the extent that the jurisdiction extends the standards to activities, devices, or situations that are not covered by the federal rule.

- Policies in a small number of jurisdictions that adopt *more stringent* standards for device emissions and certification/approval than the federal standards**.** For example, Washington state's emissions standards were stricter than the federal standards until EPA's current standards took effect in 2020. Alaska recently established a wood stove approval and listing process that includes stricter emissions testing data requirements.

Subsequent chapters of the report describe policies that *apply* emissions and certification requirements to specific actions, such as the transfer, installation, or use of wood-burning devices, as well as policies that aim to reduce emissions by prohibiting the use of wood-burning devices in certain situations.

BACKGROUND: FEDERAL REQUIREMENTS FOR NEW WOOD HEATERS

EPA first adopted emissions and certification standards for new wood heaters in 1988, as New Source Performance Standards (NSPS) authorized by Section 111 of the Clean Air Act.[95] In 2015, EPA updated the NSPS for new wood heaters. The revised rule, at 40 CFR Subpart AAA, updates and strengthens the prior federal PM emissions standards for new, adjustable burn-rate wood stoves. It also establishes federal standards for previously unregulated new wood heaters, including single burn-rate wood heaters and pellet stoves.

The new rule applies to those who manufacture, sell, import, or distribute new residential wood heaters, defined in the rule as an: "Enclosed, wood burning-appliance capable of and intended for residential space heating or space heating and domestic water heating."[96] The rule does not address fireplaces – which the agency finds are typically not "effective heaters" – or other wood-burning devices that are not used primarily for heating a home.[97]

EPA does have a *voluntary* wood-burning fireplace program that "qualifies" new, cleaner-burning fireplace models and retrofit devices for existing fireplaces. Where fireplaces are allowed in new construction, EPA will qualify models achieving a Phase II PM emissions level of 5.1 grams per kilogram (g/kg) of wood burned.[98]

A separate EPA rule, not described here, established emissions, certification, and labeling standards for "central heaters" – outdoor and indoor wood-fired boilers (hydronic heaters) and indoor wood-fired forced air furnaces.[99]

Following is a short description of the emissions and certification requirements of the wood heater rule. Other aspects of the EPA rule, including allowable fuels, are described in Chapter 3.

Emissions Standards. Prior to 2015, EPA's "Phase II" standards had been in effect since 1990. Those standards required PM emissions certification for catalytic (4.1 grams/hour or g/hr) and non-catalytic (7.5 g/hr) wood heaters.[100]

The 2015 EPA rule phased in stricter emission limits over a five-year period for a broader range of covered wood heaters. The rule required that all wood burning room heaters – including non-catalytic and catalytic stoves, pellet stoves, and single burn rate stoves – meet a "Step 1" standard by May 15, 2015, and a "Step 2" standard by May 15, 2020. The Step 2 standard that is now in effect for all new wood stoves and pellet stoves

[95] 42 U.S.C. §7411(b)(1)(B) (requiring EPA to list categories of stationary sources that "cause, or contribute significantly to, air pollution which ... endanger public health and welfare," to set NSPS for listed categories based on the best technology reasonable available, and to review the NSPS at least every eight years).
[96] 40 CFR 60.531.
[97] U.S. EPA, Understanding the Residential Wood Heater Rules, https://www.epa.gov/residential-wood-heaters/understanding-residential-wood-heater-rules.
[98] U.S. EPA, Voluntary Fireplace Program, https://www.epa.gov/burnwise/voluntary-fireplace-program.
[99] 40 CFR part 60, subpart QQQQ. According to EPA, indoor hydronic heaters account for only about 10% of the hydronic heater market. U.S. EPA, Regulatory Impact Analysis for Residential Wood Heaters NSPS at 3-4 (2015), https://www.epa.gov/sites/production/files/2015-02/documents/20150204-residential-wood-heaters-ria.pdf.
[100] See 53 Fed. Reg. 5860.

is 2.0 g/hr.[101] This standard applies to models tested using "crib" wood (lumber assembled in standardized configurations); EPA may approve alternative testing methods that use cordwood upon request; if such methods are used, the emissions limit is 2.5 g/hr.[102] EPA has approved certain test methods using cordwood.[103]

Certification and Testing Requirements for Wood Heaters. The federal rule requires that new wood heaters be certified by EPA as complying with current emissions standards, and labeled as such. The manufacturer of the heater must apply to EPA for certification of each model line.[104]

The 2015 rule retains the prior approach to compliance testing, using crib wood to test a representative heater: "For each model line manufactured or sold by a single entity (e.g., company or manufacturer), compliance with applicable emissions standards...must be determined based on testing of representative affected wood heaters within the model line."[105]

The rule requires use of EPA Method 28R for crib wood testing.[106] The manufacturer must have testing carried out by an approved test laboratory and must hire a third-party certifier to review the tests. An application for EPA certification must include the certifier's determination that the test results show the device meets the federal emissions standards, as well as all documentation of a valid test.[107] Wood heaters manufactured under an EPA certificate must be "similar [to the tested device] in all material respects that would affect emissions," and manufacturers must conduct a quality assurance program toward this end.[108] Certification is valid for five years, though manufacturers must apply for recertification earlier if they make any design change that might affect PM emissions.[109]

The rule includes an important compliance assurance provision: EPA may select wood heaters or model lines for compliance audit testing to determine whether they meet emissions standards. The agency may test the device or direct the manufacturer to have the device tested at any approved test laboratory or federal laboratory. The agency has authority to revoke a certification if compliance audit testing demonstrates that a heater exceeds emissions standards as specified in the rule. The rule also provides more generally that EPA may revoke certification if it is determined that wood heaters being manufactured or sold in a certified model line do not comply with the requirements of the rule.[110]

---

[101] 40 CFR 60.532.

[102] EPA, Fact Sheet: Summary of Requirements for Woodstoves and Pellet Stoves -EPA'S Air Rules for new Residential Wood Heaters, available at: https://www.epa.gov/residential-wood-heaters/final-2020-new-source-performance-standards-residential-wood-heaters.

[103] See 84 Fed. Reg. 7363 (approving ASTM E3053–17, ASTM E2515–11, and Canadian Standards Administration Method CSA–B415.1–10). In addition, Alaska recently requested and received approval from EPA to use a new Integrated Duty Cycle test method developed by NESCAUM that uses cordwood, and EPA will make this method available to other parties as a Broadly Applicable Test Method and will post the approval as ALT-140. U.S. EPA Letter to Alice Edwards, Director Air Quality Division State of Alaska (3/9/21), https://www.epa.gov/sites/production/files/2021-03/documents/alt_140_and_v7b_2.23.2021_ak_idc_.pdf; NESCAUM, Interim Report: Development of an Integrated Duty-Cycle Test Method for Cordwood Stoves at S-2 (Dec. 2020), available at: https://www.nescaum.org/topics/wood-biomass-combustion.

[104] 40 CFR 60.533(a), (b).

[105] 40 CFR 60.533(a).

[106] 40 CFR 60.534(a).

[107] 40 CFR 60.533(f)(1); 60.533(b)(5).

[108] 40 CFR 60.533(b)(9), (m).

[109] 40 CFR 60.533(h), (k).

[110] 40 CFR 60.533(l), (n).

The effectiveness of EPA's wood heater rule thus depends in large part on the testing used to certify devices. However, EPA and stakeholders have raised important questions about whether the current emissions testing requirements for wood heaters accurately reflect the emissions produced from operation of the device in a home. Indeed, a 2016 EPA discussion paper stated: "All stakeholders, including industry, have noted that certification values do not correlate well with in-home performance of wood heaters."[111]

This issue is important for state, local, and tribal policymakers because, as is discussed throughout the report, federal emissions certification is a core element of policies that require or incentivize the use of lower-emitting devices.

EPA has identified the *use of crib wood* during testing as one issue:

> "*Since the 2015 rule was issued, EPA believes that current testing requirements may lead wood heater manufacturers to design appliances that do not reflect their actual use – and that may not achieve the environmental benefits contemplated in the rule. The 2015 rule is based on tests that burn standardized configurations of lumber [crib wood], rather than tests that burn logs – the type of wood a typical homeowner would burn for heat*."[112]

In a discussion paper published shortly after the 2015 rule was adopted, EPA noted that the test may lead manufacturers to design their heaters in a way that could affect the emissions performance in real-world conditions: "the standardized crib has allowed manufacturers to adjust the air flow to minimize emissions during certification testing. The adjusted air flow for cribs has the potential to decrease emissions performance with cordwood, which has a different physical configuration, and therefore the air flow through the unit will be considerably different with cordwood."[113]

EPA and stakeholders have raised important questions about the current emissions testing requirements used to certify new wood heaters.

The EPA paper also noted a related issue: "It is widely recognized by stakeholders that the current test method fueling protocols for certification do not reflect the range of in-home device use, not merely due to the use of crib wood instead of cordwood, but also related to the *variability in other fuel properties and operational parameters.*"[114]

A study published in 2020 sought to "determine if the current certification approach accurately characterized typical homeowner use patterns." The study looked at how consumers use wood stoves (including variables such as user habits, household characteristics, and environmental factors) and concluded that "current

[111] U.S. EPA, Process for Developing Improved Cordwood Test Methods for Wood Heaters at 17 (2016), https://www.epa.gov/sites/production/files/2016-03/documents/discussion_paper_-_process_for_dev_imp_cwtm_030916.pdf.
[112] U.S. EPA, Final 2020 New Source Performance Standards for Residential Wood Heaters, https://www.epa.gov/residential-wood-heaters/final-2020-new-source-performance-standards-residential-wood-heaters.
[113] U.S. EPA, Process for Developing Improved Cordwood Test Methods for Wood Heaters at 15 (2016), https://www.epa.gov/sites/production/files/2016-03/documents/discussion_paper_-_process_for_dev_imp_cwtm_030916.pdf.
[114] Id. at 16 (emphasis added).

steady-state testing should be replaced with a test method that incorporates a variety of burn conditions and fuel load configurations that mimics the variable operating patterns."[115]

In March 2021, the Northeast States for Coordinated Air Use Management published the results of a "screening" review of certification test reports for 250 appliances certified as meeting EPA's Step 2 emissions standards. The review was conducted in partnership with the Alaska Department of Environmental Conservation (DEC) and funded by the New York State Energy Research and Development Authority (NYSERDA). It focused on completeness of the reports, elements that could trigger certification revocation procedures, and elements that could trigger compliance audits of the tested devices.[116] The report found "systemic" failures in the certification process, relating to test method requirements and implementation of the requirements. For example, the review found that 72 percent of the certification reports "contained issues listed as Criteria for Revocation of Certification" under EPA rules, while 24 percent of the reports "were too incomplete to make determinations."[117] The report concluded that some wood heaters certified to Step 2 standards "are not likely to consistently achieve those emission levels when in-use...." and made several recommendations for strengthening the federal program and regulatory requirements.[118]

As described in the next section, Alaska has addressed these concerns by creating its own list of approved wood heaters, based on its review of the certification data and using criteria established in state rules.

Policy Strategy: Establish Emissions and Certification Requirements

Incorporating Current Federal Emissions and Certification Standards

For the most part, the policies described in this report incorporate some version of EPA's particulate matter emissions standards for wood heaters. Many reference the 2015 standards or the pre-2015 (Phase II) standards. Some, however, have been updated to reflect the *current* (2020 or Step 2) EPA standards. This has two notable implications: first, adopting current standards allows jurisdictions to supplement federal enforcement of the restrictions on new heaters included in the federal rule; and second, jurisdictions may apply these standards to a broader set of activities than the federal rule, as described in subsequent chapters of the report.

In *Colorado*, state law requires the air agency to set emissions standards, and the state has incorporated the 2020 EPA standards for wood stoves and pellet stoves.[119] The *Placer County Air Pollution Control District* (APCD) in California adopted a rule in 2007 stating that wood-burning appliances must be certified to meet EPA emissions standards as of that date, but adding: "If a more stringent standard...has been made effective at the time of installation [of the device] by the amendment of [EPA's rule] then this more stringent

[115] M. Ahmadi, et al., "Investigation of real-life operating patterns of wood-burning appliances using stack temperature data," *J. of the Air & Waste Mgmt. Assoc*., v. 70, No. 4, 393–409 (2020), https://www.tandfonline.com/doi/full/10.1080/10962247.2020.1726838.
[116] NESCAUM, Assessment of EPA's Residential Wood Heater Certification Program at x, xii (2021), https://www.nescaum.org/documents/nescaum-review-of-epa-rwh-nsps-certification-program-202103.pdf/.
[117] Id. at iii, 71.
[118] Id. at 69.
[119] Co. Stat. §§25-7-403--404; 5 Co. Admin. Code §§1001-6:II, 6:III.

certification standard must be met."[120] Similarly, *Washoe County, Nevada* updated its rules to adopt the 2020 EPA standards and also included a provision to account for any future tightening of the EPA standard: "If the U.S. EPA adopts a more stringent emission standard, that emission standard supersedes the standard in this section and becomes effective for all new devices on the date that the U.S. EPA standard becomes effective."[121] On the other hand, some state laws adopt the federal emissions standards but expressly do *not* adopt changes in those standards after a specified date.[122]

Adopting More Stringent Emissions and Certification Standards

As noted earlier, the Clean Air Act allows states to adopt emissions standards that are more stringent than the current federal standard. *Washington* did so decades ago, pursuant to a state law requiring the Department of Ecology to establish its own or EPA's emissions standards on a statewide basis. The state adopted a standard of 2.5 g/hr for catalytic wood stoves and 4.5 g/hr for non-catalytic stoves, significantly stricter than the federal standard that was in place until EPA established its Step 2 emissions standard in 2020.[123] Washington's rule applied broadly to solid fuel burning devices, rather than solely the adjustable burn-rate wood heater category regulated by EPA at the time. The rule also specifically addresses masonry heaters and factory-built fireplaces (not covered by the federal rule), requiring that they meet EPA's 1990 standard for wood stoves or an equivalent adopted by the state.[124]

Some jurisdictions have adopted a more stringent emissions standard that applies to devices in specified situations or geographic areas. For example, *Washoe County, Nevada* has adopted a "low-emitting device" standard of not more than 1.0 g/hr, which is applied to the installation of *additional devices* in an existing property.[125] Similarly, the city of *Portola, California* has defined a "low-emitting device" as an EPA-certified wood-burning device that meets a certified emission rate of 1.0 g/hr or less (or a certified pellet heater); such devices are exempted from city restrictions on the number of EPA-certified wood-burning heaters or EPA-qualified fireplaces that may be installed in existing homes and new or remodeled properties.[126]

State policies may also provide authority to approve or certify wood-burning devices, and this authority can be used to establish stronger measures to reduce emissions. *Oregon* established a state certification requirement in 1986, and the state certified solid fuel burning devices until EPA established nationwide certification requirements in 1988.[127] More recently, *Alaska* has established its own program for approving new wood heaters, to address concerns raised about EPA's current emissions testing and certification process.

---

[120] Placer County APCD Rule 225, §301.
[121] Washoe County (NV) Health District Regs. §040.051(C)(1) (emphasis added). The rules define "EPA certified" as "a wood-burning device that has been certified in accordance with current standards adopted by the U.S. EPA." Id. §040.051(B)(6).
[122] See, e.g., Wis. Stat. §285.27(5) (prohibiting enforcement of federal standards, or adoption of state standards, more stringent than federal standards in effect before 2015); Mich. Stat. §324.5514 (prohibiting enforcement of federal standards adopted after May 2014).
[123] Rev. Code Wash. §§70A.15.3530(1)(a), .3000(2)(b); Wash. Admin. Code §173-433-100(3). Wash. Dept. Ecology, Wood Stoves & Other Home Heating, https://ecology.wa.gov/Air-Climate/Air-quality/Smoke-fire/wood-stove-info.
[124] Wash. Admin. Code §173-433-100. Wash. Dept. Ecology, Wood Stoves & Other Home Heating, https://ecology.wa.gov/Air-Climate/Air-quality/Smoke-fire/wood-stove-info.
[125] Washoe County (NV) Health District Regs. §§040.051(C)(2)(a)(2), 040.051(C)(2)(c)(1)).
[126] City of Portola (CA) Mun. Code §§15.10.030(B), 15.10.040(B).
[127] Or. Rev. Stat. §468A.465. See also Oregon Dept. of Envtl. Quality, Wood Stove or Fireplace Insert Certification Labels, https://www.oregon.gov/deq/Residential/Pages/CertLabels.aspx.

Alaska's List of Certified Wood Heaters. Alaska state regulations require, beginning in 2020, that wood-burning devices installed in the Fairbanks North Star Borough $PM_{2.5}$ serious nonattainment area be separately evaluated and approved by the state according to approval criteria set forth in the rules.[128]

To implement these rules, the Alaska DEC has undertaken to review testing data for EPA-certified wood heaters and restrict state approval to devices that meet DEC data standards. According to agency rules, wood stoves and pellet stoves with a capacity of less than 350,000 British thermal units (Btu) per hour must:

- Be certified by EPA under federal rules adopted as of July 2019 "for which the department has reviewed and accepted the underlying certification test results"; and

- Meet an emission standard of 2.0 g/hr, using the test methods in the EPA rules (or other method approved by EPA and DEC), with test results "approved by the department together with the supporting data."[129]

The Alaska DEC rules establish additional requirements, to be met using one of two emission concentration measurements specified in the rule – either (1) one-hour filter data from the EPA certification report for the device, not to exceed 6.0 g/hr, or (2) tapered element oscillating microbalance (TEOM) measurement, not exceeding 4.0 g/hr in a 60-minute rolling period.[130] The rule is notable for incorporating an emissions requirement for the first hour of burning – when emissions may be highest – rather than relying only on an average over a longer period.[131]

The DEC has implemented these rules by applying its standards to the testing data for every device listed as EPA-certified and by requesting additional information from manufacturers as needed. Based on this review, the agency has developed its own list – a subset of the larger EPA list of certified devices – of new devices that are considered approved to be sold or installed in the state's serious nonattainment area.

The Alaska DEC has published its *list of approved wood heaters* on the agency web pages.[132] The DEC has also posted the findings of each of the test reports it reviewed.[133] These resources are available to other jurisdictions considering policies and programs to address wood heater emissions.

[128] 18 Ak. Admin. Code §50.077. The requirement applies to wood stoves, pellet stoves, hydronic heaters, and other wood heaters with a capacity of 350,000 Btu/hr or more.
[129] 18 Ak. Admin. Code §50.077(2), (3)(D).
[130] 18 Ak. Admin. Code §50.077(c)(3)(B). See also Alaska DEC, Solid Fuel-Fired Heating Device Standards and Requirements, https://dec.alaska.gov/air/burnwise/standards/. The TEOM method provides real-time emissions throughout the testing cycle. The Alaska DEC rules state that TEOM data must be obtained following TEOM procedures developed by the NESCAUM.
[131] See NESCAUM, Assessment of EPA's Residential Wood Heater Certification Program at 61 (2021), https://www.nescaum.org/documents/nescaum-review-of-epa-rwh-nsps-certification-program-202103.pdf/ (noting that "almost all the emissions from residential wood heating are emitted in the first few hours after fuel loading" and that test runs can last from 3 to more than 30 hours).
[132] Alaska DEC, Woodstoves Meeting Emission Standards for the Fairbanks North Star Borough $PM_{2.5}$ Nonattainment Area (rev. 3/2/21), available at: https://dec.alaska.gov/air/burnwise/regulations. See also 18 Ak. Admin. Code §50.077(e).
[133] Alaska DEC, Manufacturers and Vendors, https://dec.alaska.gov/air/burnwise/manufacturers-vendors/#Lists.

CHAPTER 2
Sale, Transfer, and Installation of Devices

Policies governing the sale, transfer, and installation of wood-burning devices can help speed the transition to lower-emitting devices. EPA's wood heater rule aims to do this by restricting the manufacture and sale of *new* wood heaters to those that meet the federal emissions and certification standards.

This chapter discusses policies that go beyond the federal rule in implementing two broad policy strategies:

- Limiting the Sale or Transfer of Noncompliant Devices. A number of jurisdictions include a restriction on the sale or transfer of devices that extends beyond the scope of the federal rule – for example, by restricting transfers of used as well as new devices. In addition, some policies take advantage of an important opportunity to transition to less-polluting heating devices: the real estate transaction. These laws and regulations require removal or destruction of noncompliant devices when the property in which they are located is transferred to a new owner.

- Restricting New Installations of Wood-Burning Devices. Establishing requirements for the installation of devices can supplement, and provide additional oversight of, regulatory restrictions on the transfer of new and used devices. Like transfer restrictions, this approach does not affect the use of existing devices by their current owners, but can help ensure that homes will not *add* devices beyond those specified by the policy. This can help reduce emissions and avoid the difficult prospect of restricting use of the device in the future.

POLICY STRATEGY: RESTRICT THE SALE OR TRANSFER OF NONCOMPLIANT DEVICES

Transferring Wood-Burning Devices

EPA's wood heater rule applies to the "sale" of covered devices, defined broadly as the "transfer of ownership or control."[134] A core requirement of the rule is that commercial sellers may not sell a device unless it is certified and labeled as meeting the current federal emissions standards. The rule also prohibits the sale of a device unless it includes any mandated EPA label.[135]

In addition to implementing and enforcing these requirements itself, EPA may delegate implementation and enforcement of many elements of the rule to a state, local, or tribal government upon request.[136] A number

[134] 40 CFR 60.538(a), .531.
[135] 40 CFR 60.538(a), (c). This provision applies to wood heaters manufactured and labeled on or after July 1, 1988. 40 CFR 60.530(a).
[136] 40 CFR 60.539a. Even in such cases, EPA retains authority to enforce the rule. The agency may not delegate items such as setting federal emissions standards or issuing federal device certifications.

of states (and local agencies) have received full or partial delegation of authority for the wood heater rule.[137] Even where a jurisdiction has not received formal delegation, it may incorporate the federal standards into its own laws and regulations and enforce the requirements as state law.[138] Although EPA has authority to enforce the sale/transfer requirements nationwide, state and local enforcement can be an important supplement to the limited federal enforcement presence.

State and local wood-burning device laws and regulations commonly include an express prohibition similar to that in the federal rule, barring the sale or transfer of new wood-burning devices that do not meet a specified standard, typically the federal standard in effect at the time that the device was initially manufactured or sold. Some state and local policies, though, are framed more broadly to encompass non-commercial transfers of devices, including those that may have been exempt from federal certification requirements at the time of manufacture. For example:

- *Colorado* regulations prohibit people from selling new or used wood-burning devices unless they meet current (Step 2) EPA certification and emissions performance requirements for wood stoves.[139]

- *Oregon* law prohibits the sale of used wood stoves unless they have been certified for sale as new by EPA or the state.[140]

- *Vermont* law prohibits any person from selling or purchasing a wood heater after December 15, 2015 unless it has been certified by EPA.[141]

- *Washington* state makes it unlawful to "advertise to sell, offer to sell, sell, bargain, exchange, or give away a solid fuel burning device" unless it is certified and meets emissions standards. Prior to May 2020, Washington's emissions standards were stricter than federal standards.[142]

- *Alaska* rules prohibit a person from selling, leasing, or conveying a wood stove or pellet stove for use in the nonattainment area unless the device is certified and meets a particulate matter annual average emission limit of 2.0 grams per hour.[143]

Washoe County, Nevada is unusual in requiring the reporting of device sales: any "person who sells a wood-burning device for use within the Health District" must report the sale to the county within 30 calendar days by submitting a designated form, along with payment of a fee.[144] Such a provision could help jurisdictions

[137] See 40 CFR 60.4.
[138] See, e.g., Minn. Admin. Rules §7011.2950; Wy. Rules and Regulations 020.0002.5, §2; N.H. Code Admin. R. §Env-A 503.01; Mich. Admin. Code §R 336.1902. In some cases, states incorporate an older version of EPA standards and thus do not enforce the current regulations. Additionally, state regulations expressly *do not* incorporate the federal standards. See, e.g., Va. Stat. §10.1-1307; W. Va. Code St. R. §45-16-4; 15A N.C. Admin. Code §02D.0524.
[139] 5 Co. Admin. Code §§1001-6:II(A),(D); Co. Stat. §25-7-405.5. See also 5 Co. Admin. Code §1001-6:I(A)(17) (defining a "new wood stove" as "any wood-burning stove other than one which was sold to an individual for personal use prior to January 1, 1987").
[140] Or. Rev. Statutes §468A.500.
[141] Vt. Admin. Code 12-031-001, §§5-204(c)(1), (d)(1).
[142] Wash. Admin. Code §173-433-100; Rev. Code Wash. §70A.15.3530.
[143] 18 Ak. Admin. Code §§50.077(a),(c).
[144] Washoe County (NV) Health District Regs. §040.051(E)(3).

focus outreach and education programs, as well as monitor compliance with any regulatory restrictions on wood burning.

Transferring Property that Contains a Wood Heater: Leveraging the Real Estate Transaction

Policymakers can leverage another type of transfer – the indirect conveyance of a device as part of the transfer of real property – to facilitate a transition to lower-emitting devices.

The purchase and sale of a home is an important time for identifying and carrying out needed improvements, as the parties are already negotiating financing and other terms of the transaction. A majority of states have adopted property disclosure requirements aimed at protecting consumers (purchasers) by requiring sellers to provide information about a broad range of conditions – from lead paint and radon to termite damage.[145] Though less common, some states and localities have laws or regulations requiring a seller to take affirmative measures to investigate certain conditions on the property and disclose the results.[146] The involvement of real estate professionals in a transaction can facilitate compliance with these requirements. Ultimately, though, compliance with property disclosure requirements is enforced privately by the parties.

State and local disclosure laws require information about the known condition of home appliances and fixtures, and thus may include information about any known problems with wood-burning devices present on the property. Some states and localities have gone further than requiring disclosure of known defects by prohibiting the transfer of noncompliant wood-burning devices in connection with transfer of the property. This policy strategy advances the goal of taking older devices out of use while minimizing restrictions on the use of devices by their current owners.

Several jurisdictions require removal of noncompliant wood-burning devices when a home is sold.

This section provides information about real estate transfer policies in several jurisdictions – *Alaska, Oregon, Missoula (Montana), Portola (California), Washoe County (Nevada)*, the *Tahoe Regional Planning Agency (California/Nevada)* and two California air pollution districts: *Placer County* and *San Joaquin Valley.*[147]

Transactions Covered. This discussion refers to property "transfers" in describing the types of restrictions states and localities have imposed. The specific terms and definitions used in a law or regulation are important for determining whether a particular transfer (e.g., other than a traditional sale) is covered. Most of the policies reviewed for this report use the terms "sale," "transfer," and/or "conveyance." Portola's policy refers to "escrow transactions." Alaska's requirements are unusual in applying to the *leasing* of property as well as sales.[148] Both residential and commercial properties are typically covered, except in the case of Oregon's requirements, which apply only to the sale of a residential structure. Most of the policies reviewed apply to transactions that take place anywhere in the jurisdiction, and Oregon is notable for having a

[145] See generally, Envtl. Law Inst., Radon in Homes (2012) (describing radon provisions of state property disclosure laws). Disclosure is commonly limited to conditions that a seller knows or should know about.

[146] See, e.g., N.J. Stat. §§58:12A-26, et seq.; N.J. Adm. Code §§7:9E, et seq. (testing of private drinking water wells); Iowa Code §455B.172; Ia. Adm. Code §567-69.2 (455B) (testing of private septic systems); Montg. County (MD) Mun. Code §40-13C (testing for radon).

[147] The main provisions discussed in this section are found in the following policies, and additional citations to the policies are provided in this section only as necessary to clarify: 18 Alaska Admin Code §50.077 (l); Or. Rev. Stat. §468A.505, Or. Admin Code §340-262-0700; Missoula (MT) City-County Air Pollution Rules §9.501; Portola (CA) Mun. Code §15.10.040(A); Washoe County (NV) Health District Regs. §040.051(C)(2); Placer County APCD Rule 225, §303.1; San Joaquin Valley Unified APCD Rule 4901, §5.2.2; Tahoe Regional Planning Agency Code of Ord. §65.1.4(B)(3).

[148] Compliance is required before the commencement of the lease term. 18 Ak. Admin. Code §50.077(l).

statewide requirement. In Alaska, the measure applies only in the nonattainment area and in Missoula, only to the Air Stagnation Zone.[149]

Types of Devices Covered and Exempted. The policies reviewed here differ somewhat in terms of which wood-burning devices are allowed to remain in a home, and which must be removed. The most common approach is to require generally that a device has been *certified* in order to be transferred with a property. None of the policies apply to masonry fireplaces, but the specific types of wood heaters covered vary.[150] The city of Portola is unusual in including a limit on the *number* of certified wood-burning heaters that may be transferred, capping it at two certified devices.

A few of the policies reviewed go beyond a general certification requirement (that is, certified per standards in effect when the device was new) to include specific emissions standards that must be met.

- In Washoe County, wood heaters may only be transferred with the property if they are certified (defined as meeting current EPA standards); uncertified wood heaters may be replaced with a certified heater or other "low-emitting device" (defined as certified to meet an emissions standard of 1.0 g/hr or less).[151] The county also allows the transfer of wood stoves, fireplace inserts, and pellet stoves certified before 2020 if they were certified to emit 2.5 g/hr or less.

- Alaska's removal requirement applies not only to uncertified wood-burning devices, but also to certified devices that are at least 25 years old and are not certified to an emissions standard of 2.0 g/hr or less.[152]

- In Missoula, old wood stoves and pellet stoves may remain in a transferred property only if they meet stated emissions standards. But, as described in the next section, since 1994 the only devices allowed to be installed in the Air Stagnation Zone are pellet stoves emitting 1.0 g/r or less.[153]

In general, the laws and regulations reviewed here do not establish exemptions to the real estate transfer restrictions. Alaska will consider temporary waivers on a case-by-case basis after considering financial

[149] 18 Ak. Admin. Code §50.077(l); Missoula (MT) City-County Air Pollution Rules § 9.501.
[150] 18 Ak. Admin. Code §50.077(l) ("uncertified woodstove or pellet stove or a non-pellet fueled wood-fired outdoor hydronic heater); Or. Admin Code §340-262-0700 (uncertified solid fuel burning devices, with exemptions including fireplaces, pellet stoves, masonry heaters, antique stoves, and central wood-fired furnaces); Portola (CA) Mun. Code §15.10.040 (EPA-certified wood-burning devices); Placer County APCD Rule 225, §303.1 (free-standing wood stove must be certified as meeting EPA Phase II standards); San Joaquin Valley Unified APCD Rule 4901, §5.2.2 (wood-burning space heaters must be certified as meeting EPA Phase II standards or pellet-fueled heaters exempt from certification); Tahoe Regional Planning Agency Code of Ord. §65.1.4(B)(3) (wood heaters meeting at least EPA Phase II emissions standards or pellet heaters exempt from those standards).
[151] Washoe County (NV) Health District Regs. §§040.051(C)(2)(a)(3), (B)(6), (B)(10). An exemption is available for antique wood heaters.
[152] 18 Ak. Admin Code §§50.077(l),(n). Uncertified pellet stoves that meet the emissions limit may remain. Ak. Dept. of Envtl. Cons., ADEC Real Estate Contingency Measure, at: https://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-real-estate/#realtors. As described below, uncertified wood heaters that have not been removed in the nonattainment area by the end of 2024 must be removed.
[153] The emission limits for older devices are 6.0 (Oregon Method) or 5.5 grams/hour (EPA Method). Missoula (MT) City-County Air Pollution Rules §§9.501, 9.203. *See also* Missoula Public Health, Wood Stove Installations, https://www.missoulacounty.us/government/health/health-department/home-environment/air-quality/stove-installations.

hardship, technical feasibility, and potential impact to locations with populations sensitive to exposure to particulate matter.[154]

Requiring Removal or Destruction of Noncompliant Devices. Most of the policies reviewed here prohibit the transfer of property containing noncompliant devices *and* expressly require that the device be removed and/or destroyed.

Requiring that a noncompliant device be *destroyed or rendered permanently inoperable* aims to ensure that the device will not be used anywhere in the future, and may be combined with a requirement for removal. Oregon, San Joaquin Valley APCD, Placer County APCD, and the city of Portola are examples of policies that include this requirement.[155]

The Placer County APCD has developed guidance for complying with its requirement to render a device permanently inoperable, which lists several approved methods of destruction: knocking the door hinges off of the body of the stove with a sledge hammer; torching, cutting, or drilling a complete hole (not less than 2 inches) through the side of the stove's fire box; crushing the stove so the door can no longer close; and filling the fire box with concrete. The buyer or seller must contact the district for approval to use a different method.[156] Oregon also provides information on its webpage recommending how to destroy a device – e.g., by permanently removing the door and hinges and by cutting holes in the top and sides of the device at least four inches in diameter. The agency notes that an uncertified wood stove or fireplace insert "is considered destroyed when it is demolished to the extent that it cannot be restored or reused as a heating device."[157]

Alternatively, a requirement for a device to be *removed,* combined with legal restrictions on installation (described in the next section), can help ensure that the device is not used in the future in the area covered by the policy. Such devices might, though, be lawfully sold and installed in another jurisdiction. This approach reduces the potential economic loss for owners of older devices who wish to re-sell their devices. Jurisdictions allowing noncompliant devices to be removed without also destroying the device include Alaska, Missoula, Washoe County, and the Tahoe Regional Planning Agency. Alaska law requires noncompliant devices to be "rendered inoperable," but does not require destroying the device; if the device is removed from the property, it may not be reinstalled within the nonattainment area but could be used outside of that area.[158]

---

[154] Alaska DEC., Real Estate requirement - Fairbanks North Star Borough PM2.5 Nonattainment Area, https://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-real-estate/#regulations.

[155] Or. Admin. Code §340-262-0700 ("removed and destroyed"); San Joaquin Valley APCD Rule 4901, §5.2.2.2.3 ("rendered permanently inoperable and removed"); Placer County APCD Rule 225, §§213, 303 (defining "permanently inoperable" and requiring the District to develop guidance to implement the rule); Portola (CA) Mun. Code §15.10.040(A)(7) ("removed from the property and destroyed/recycled at an approved facility or agency").

[156] Placer County APCD, Procedure for the Implementation of the Point of Sale/Transfer Condition for Non-Certified Free Standing Wood Stoves at 6 (2011), https://www.placerair.org/1664/Point-of-Sale-Information.

[157] Oregon Dept. of Envtl. Quality, Frequently Asked Questions About Woodstoves, https://www.oregon.gov/deq/Residential/Pages/woodstovesFAQ.aspx#item10. The state requires proof of proper disposal of devices that were removed and decommissioned. Oregon DEQ, Buying or Selling Wood Stoves, https://www.oregon.gov/deq/residential/pages/heatsmart.aspx.

[158] 18 Ak. Admin. Code §§50.077(l),(a). See also, Missoula (MT) City-County Air Pollution Rules §9.2029.501 ("removed...*or* rendered permanently inoperable"); Washoe County (NV) Health District Regs. §040.051(C)(2)(a)(3) ("removed or replaced"); Tahoe Regional Planning Agency Code of Ordinances §65.1.4(B) (structure may "not contain any existing noncompliant wood heaters").

Implementation: Written Certification of Compliance. One challenge in establishing a requirement to remove noncompliant devices during property transfers is how to oversee and monitor compliance. A common approach among the jurisdictions reviewed is to require certification of compliance.

Self-Certification of Compliance. Several of the policies reviewed here require that a party to the transfer submit written proof of compliance on forms provided by the jurisdiction, which include basic information about the device. In most cases, parties must provide information about any wood-burning devices that will be transferred with the property. Oregon provides a form that can be submitted online.[159]

Policies vary in terms of who must sign the certification and when the form must be submitted. Oregon's form may be submitted by the seller, the buyer, or the contractor removing the wood stove.[160] The Placer County and San Joaquin Valley APCDs require forms to be signed by both the seller and the buyer.[161] In Missoula, a Certificate of Compliance must be signed by the seller, the buyer, and the seller's real estate agent and filed with the Missoula County Clerk and Recorders Office**.**[162]

Not all policies reviewed specify when the certification must be submitted. The San Joaquin Valley APCD has determined that the form must be provided within 30 days of the close of escrow.[163] Placer County APCD guidance requires the form to be submitted no later than the close of escrow; however, the policy allows the buyer to destroy all non-certified stoves within 30 days after the close of escrow. The guidance advises that both parties may be held responsible for any noncompliance and that the buyer remains liable for compliance following the transfer.[164] The Tahoe Regional Planning Agency requires the statement to be submitted prior to a transfer, and the requirement applies to subsequent transfers as well.[165]

Alaska uses a somewhat different oversight tool, requiring registration of wood heaters located within any property that is subject to the real estate transfer restriction.

Third-party Certification of Compliance. Some policies add another layer of oversight, requiring certification to be issued by the jurisdiction and/or a third-party inspection. Washoe County regulations require that if a wood-burning device is transferred with the property, the current owner must obtain a Certificate of Compliance from the county prior to completing the transfer, deeming the device EPA-certified and in compliance with the regulation. In conjunction with a request for the certificate, an inspection must be performed and a report submitted to the county by a Wood-burning Device Inspector who has been approved by the county after completing an initial training course and paying an annual fee. If uncertified

---

[159] *See* Oregon Dept. of Envtl. Quality, Buying or Selling Wood Stoves, https://www.oregon.gov/deq/residential/pages/heatsmart.aspx.
[160] Oregon Dept. of Envtl. Quality, Buying or Selling Wood Stoves, https://www.oregon.gov/deq/residential/pages/heatsmart.aspx.
[161] Placer County APCD, Wood Stove Statement of Compliance Disclosure at Point of Property Sale/Transfer, available at: https://www.placer.ca.gov/1664/Point-of-Sale-Information; San Joaquin Valley APCD, Wood Burning Heater Statement of Compliance, http://www.valleyair.org/BurnPrograms/Wood-BurningHeaterStatementofCompliance.pdf.
[162] Missoula City-County Air Pollution Rules § 9.501. *See also* Missoula City-County Health Department, Certificate of Compliance for Solid Fuel Burning Devices, https://www.missoulacounty.us/home/showdocument?id=24859.
[163] San Joaquin Valley Air Poll. Control District, Residential Wood Burning Rule 4901, http://valleyair.org/rule4901/.
[164] Placer County APCD, Procedure for the Implementation of the Point of Sale/Transfer Condition for Non-Certified Free Standing Wood Stoves at 5 (2011), https://www.placerair.org/DocumentCenter/View/1483/Procedure-Manual-PDF.
[165] Most policies appear to require certification for all subsequent transfers. Missoula's rule, however, requires a certificate only for the first time a property is transferred if the number and type of wood stoves remains the same thereafter. Missoula Public Health, Summary and Explanation of Changes to the Missoula City-County Air Pollution Control Program (11/05/2019), https://www.missoulacounty.us/home/showdocument?id=71017.

wood-burning devices were removed to comply with the regulation, the property is subject to a verification inspection for up to 30 days after the transaction.[166]

Similarly, Portola's ordinance establishes that if there are wood-burning heaters on the property, it is unlawful to complete an escrow transaction unless the city's Control Officer has issued a Certificate of Compliance. The ordinance requires either a physical inspection by the city or documentary evidence (including a receipt or invoice for the installation or purchase) that the EPA-certified wood-burning heater on the premises has been installed in compliance with all applicable municipal codes. The Control Officer may conduct audits after properties have closed escrow and must order the destruction and recycling of any uncertified wood-burning heaters. In Missoula, if any solid fuel burning devices will remain on the property, the City Building Department or a private inspector certified by the department must inspect the devices, provide a report, and sign the required certificate.

Implementation: Information and Awareness. Jurisdictions can help ensure that people are aware of and understand the property transfer restrictions by requiring that information be provided as part of the transfer and by providing general outreach to the community.

As noted earlier, a majority of states already require some type of mandatory property condition disclosure that must be given to buyers. Oregon's property disclosure law requires the seller to indicate, for any wood stove or fireplace insert included in the sale, the make of the device, whether it was installed with a permit, and whether it has an EPA or Oregon certification label.[167]

States could go further by requiring a description of any restrictions on device transfer. This information could be provided as part of the disclosure form or in separate forms that must be provided during the transaction. In the Placer County APCD, the required wood-burning device certification is crafted as a disclosure form that must "be included with all of the real estate forms given to both sellers and buyers." The policy leverages the involvement of real estate professionals as a means of facilitating compliance, but holds seller and buyer responsible for compliance.[168]

Several jurisdictions reviewed here have created web-based materials and conducted direct outreach to educate the public and the real estate community about property transfer restrictions. The Alaska DEC has focused outreach especially on real estate licensees, who can play an important role in ensuring compliance. The agency issued several Advisory Letters to real estate licensees explaining updates to the rule. The letters are included on an agency web page that also provides agency contact information, an interactive map for determining whether a property is covered, and information directed to property owners, buyers, and landlords.[169] Ensuring that real estate licensees have information about regulatory requirements is important

[166] If the county fails to issue the appropriate certificate within 14 days of a request, the transaction may proceed without it. Washoe County (NV) Health District Regs. §§040.051(C)(2)(a)(3), (D)(2), (D)(3), (B)(2).
[167] Or. Rev. Stat. §105.464. The requirement applies to real property consisting of or improved by one to four dwelling units, condominiums, and certain manufactured homes.
[168] Placer County APCD, Procedure for the Implementation of the Point of Sale/Transfer Condition for Non-Certified Free Standing Wood Stoves at 5 (2011), https://www.placerair.org/DocumentCenter/View/1483/Procedure-Manual-PDF ("if the form is not provided to either the seller or buyer by a third party (such as an agent/broker) for whatever reason, then the seller or buyer will still be held responsible for compliance....")
[169] Alaska DEC, Real Estate Requirement – Fairbanks North Star Borough PM2.5 Nonattainment Area, https://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-real-estate/.

for promoting compliance, as licensees often are bound by law and/or professional standards to provide this information to their clients.[170]

Missoula, Oregon, and Placer County APCD also have webpages devoted to their real estate transfer rules. Oregon's web page includes information about potential consequences of noncompliance: "Fines start at $750 for noncompliance. In addition, your insurance company may invalidate your homeowner's insurance or the mortgage company may delay the home sale if they discover an uncertified wood heating device was not removed, destroyed and reported to DEQ."[171]

Policy Strategy: Restrict the Installation of Noncompliant Devices

This section discusses policies that regulate what types of wood-burning devices may be installed in existing homes and in homes undergoing construction or renovation.

The model building codes adopted by many jurisdictions establish minimum safety standards, including combustion safety, for the installation of solid fuel burning devices.[172] However, additional measures are important for addressing the goal of reducing wood smoke emissions. Health and environmental laws and regulations that restrict wood heater and fireplace installations can supplement and be integrated with existing building code provisions.

Restrictions on new installations of wood-burning devices can help prevent wood smoke problems and avoid the challenges of having to regulate residential wood-burning activities in homes. This section describes policies that:

- Limit wood heater installations;
- Limit fireplace installations; and
- Establish standards or other requirements for the installation process.

Wood Heater Installations

In general, the policies reviewed here allow certain types of wood heaters to be installed. The rules of the *San Joaquin Valley APCD* are unusual in prohibiting new installations of *any* wood-burning devices at

[170] In Alaska, e.g., licensees must disclose "all material information known by a licensee regarding the physical condition of a property." See Ak. Dept. of Commerce, Alaska Real Estate Commission Consumer Disclosure, https://www.commerce.alaska.gov/web/portals/5/pub/rec4145.pdf. In Nevada, real estate licensees have a duty to "disclose to the client material facts of which the licensee has knowledge concerning the real estate transaction." State of Nevada, Residential Disclosure Guide at 11, https://red.nv.gov/uploadedFiles/rednvgov/Content/Publications/References/RDG_oct2015.pdf.

[171] Oregon Dept. of Envtl. Quality, Frequently Asked Questions about Wood Stoves, https://www.oregon.gov/deq/Residential/Pages/woodstovesFAQ.aspx. *See also* Missoula Public Health, Wood Stove Removal Program, https://www.missoulacounty.us/government/health/health-department/home-environment/air-quality/wood-stove-removal; Placer County APCD, Point of Sale Information, https://www.placer.ca.gov/1664/Point-of-Sale-Information.

[172] See, e.g., International Residential Code 2018 §§ M1414, M1401, M1004.1, R1001; International Mechanical Code 2021 §§903—905; International Building Code 2018 §2111.

elevations below 3,000 feet in areas with natural gas service, unless retrofitting or replacing an existing device to a cleaner device.[173]

Most of the policies described below apply to installation of wood heaters generally, including those in existing homes. Policies limited to installations that are part of home construction or renovation/remodeling are noted separately.

Requiring Certified Devices. A common approach to restricting new installations of wood-burning devices is to require that installed devices be EPA-certified.

In some cases, these policies do not require certification to the most current EPA standards. The city of *Portola, California* has adopted the following restriction: "No person shall...install in any residence or other structure any wood-burning heater within the City limits unless it is an EPA certified wood-burning heater at the time of sale or transfer."[174] *Utah* prohibits installation of a wood-burning stove that is not EPA-certified.[175] *Oregon* law prohibits installation of used wood stoves, unless the device was certified for sale as new.[176] *Arizona* requires counties that contain specified air quality zones to prohibit installation or construction of solid fuel burning appliances in those areas unless they meet EPA Phase II standards or the equivalent.[177]

The *Placer County APCD* incorporates the EPA Phase II emissions standards, but takes an unusual approach: if more than one wood heater is installed, the *total emissions* from the appliances may not exceed the Phase II emissions standards specified for a single non-catalytic wood-burning appliance.[178]

Colorado is an example of a jurisdiction that limits installations to devices that meet the *current* EPA standards, rather than older (e.g., Phase II) standards. State regulations prohibit installation of new or used wood-burning devices unless they meet current EPA certification and emissions performance requirements for wood stoves.[179]

Requiring Stricter Emissions Standards than the Federal Rule. Some jurisdictions limit installation to devices meeting emissions or certification standards that are more stringent than current EPA standards.

- In *Washoe County, Nevada*, new installation of a wood heater in an existing property is prohibited unless the device is "low-emitting" – defined as a "wood-burning device certified by the manufacturer, to meet an emission rate of 1.0 gram or less of particulate matter per hour."[180]

[173] San Joaquin APCD Rule 4901, §§ 5.4.2.1, .2.
[174] City of Portola (CA) Mun. Code §15.10.030(A)(1). EPA-certified is defined as "any wood burning heater with a Phase II certification or a more stringent certification as currently enforced in the NSPS." Id. §15.10.020(8). The Tahoe Regional Planning Agency is another example of a jurisdiction that limits wood heater installations to those that meet EPA's Phase II standards. Tahoe Regional Planning Agency Code of Ord. §65.1.4(B)(3). Placer County APCD limits installation in the Squaw Valley area to EPA Phase II certified heaters, pellet-fueled heaters, masonry heaters, or equivalent device approved by the District. Placer County APCD Rule 225, §302.
[175] Utah Admin. Code § R307-302-6.
[176] Or. Rev. Stat. §468A.495.
[177] Az. Stat. §11-875. The law directs counties with designated air pollution areas to adopt and enforce ordinances to this effect. *See, e.g.*, City of Cottonwood (AZ), Mun. Ord. §8.56.050.
[178] Placer County APCD Rule 225, §302.3.2. Pellet fueled wood-burning heaters and masonry heaters are excluded from this provision.
[179] 5 Co. Admin. Code §§1001-6:II(A),(D); Co. Stat. 25-7-405.5. See also 5 Co. Admin. Code §1001-6:I(A)(17) (defining a "new wood stove" as "any wood-burning stove other than one which was sold to an individual for personal use prior to January 1, 1987").
[180] Washoe County (NV) Health District Regs. §040.051(C)(2)(a)(2).

- Similarly, *Missoula* regulations include a strict requirement for installation of new and used solid fuel burning devices within the designated Air Stagnation Zone: Since 1994, only pellet stoves with emissions not exceeding 1.0 g/hr may be installed. Outside the Air Stagnation Zone, residents may install EPA-certified wood stoves and pellet stoves; they may also install other devices with emissions of 7.5 g/hr or less that are approved by the Health Department. The department provides an interactive map to help county residents determine what types of device they can install.[181]

- In *Alaska's* serious nonattainment area, installation or reinstallation of wood stoves and pellet stoves is restricted to EPA-certified devices that meet an emissions limit of 2.0 g/hr *and* for which the department has reviewed and accepted the underlying certification test results.[182]

Washington state's emissions standards for installations exceeded federal standards until May 2020, when the current federal standards took effect.[183]

Many current policies specify which types of wood-burning devices may be installed in existing and new homes.

The *Yurok Tribe* adopted a policy limiting installation or replacement of wood-burning stoves (or other heating systems) to those that are included in the tribe's list of "energy efficiency and low emission" devices, defined in the code as one that "uses at least 25 percent less energy, and generates at least 25 percent less emissions than standard models." The policy allows waivers to be granted in cases of severe economic hardship.[184]

Limits on the Number of New Installations. Rules of the *Tahoe Regional Planning Agency* restrict multi-residential projects of five or more units to one wood heater per project area, and further require that wood heaters "be sized appropriately for the space they are designed to serve."[185] In areas of the *San Joaquin Valley APCD* that are located above 3,000 feet or that lack natural gas service, up to two wood-burning heaters may be installed per acre, and only one per dwelling unit; the devices must be EPA certified as meeting federal emissions standards at the time of installation.[186] In the city of *Portola, California*, existing dwelling units that already have two EPA-certified wood heaters may only install additional wood heaters that are "low-emitting" – i.e., certified wood heaters that meet a certified emission rate of 1 g/hr or certified pellet heaters.[187]

Limits on Remodeling or Replacement of Devices. The *Mendocino County Air Quality Management District* in California prohibits the replacement of non-wood-burning appliances with wood-burning appliances in any

[181] Missoula City-County Air Pollution Rules §§ 9.201–9.202, 9.103(a)–(b); Missoula City-County Department of Health, Wood Stove Installations, https://www.missoulacounty.us/government/health/health-department/home-environment/air-quality/stove-installations.
[182] 18 Ak. Admin. Code §50.077(a),(c). As noted earlier, Department has developed a list of these devices. Alaska DEC, Woodstoves Meeting Emission Standards for the Fairbanks North Star Borough PM2.5 Nonattainment Area (rev. 9.9.20), available at: https://dec.alaska.gov/air/burnwise/regulations.
[183] Rev. Code Wash. § 70A.15.3520; Wash. Admin. Code §§ 51-50-1203.2.1--.3, 51-50-1204.1--.3; 51-51-0303 (R303.10).
[184] Yurok Tribal Code (Air Quality) §§ 21.05.040, .060. The code requires the tribe to "strive to include affordable models" on the list.
[185] Tahoe Regional Planning Agency Code of Ord. §65.1.4(B).
[186] San Joaquin APCD Rule 4901, §5.4.2.2. Installation of a wood-burning fireplace, low mass fireplace, or masonry heater is prohibited.
[187] City of Portola (CA) Mun. Code §15.10.040(B).

building.[188] In *Marin County, California* a person may not install a wood-burning *replacement* for an existing wood-burning device unless the replacement is either a pellet stove or a wood heater certified to meet emissions standards at the time of installation; in addition, existing noncompliant devices may not be remodeled.[189]

Restrictions on New Installations in Rental or Multi-Unit Housing. In the *Placer County APCD*, approved devices may be installed in multi-unit residential buildings only in the public areas of the building.[190] The *Mendocino County AQMD* prohibits installation of wood-burning appliances in new or remodeled multi-unit buildings except when replacing an existing appliance.[191]

A related strategy is to prohibit rental dwellings from having or using wood-burning devices as the sole or primary source of heat. *Klamath County, Oregon* and California's *Bay Area Air Quality Management District* are examples of jurisdictions with this type of restriction, while *New York City* prohibits generally the operation of a wood heater as a primary source of heat.[192] *Alaska* law was recently amended to prohibit installation of a wood-fired heating device as the primary or only heat source in rental housing located in the serious nonattainment area, unless the home was used as rental property before January 8, 2020 and qualified for a waiver as having no other adequate heat source.[193]

Prohibiting Installation in New Construction and Remodels. One straightforward approach to reducing wood smoke emissions in the new housing stock is to prohibit new homes from including wood-burning devices.

The *Bay Area AQMD* has established a broad prohibition along these lines. The district's rules provide that *"*no person or builder shall install a wood-burning device in a new building construction" and define wood-burning device broadly to include "[a]ny wood heater, fireplace, or any indoor permanently installed device used to burn any solid fuel for space-heating or aesthetic purposes."[194] One jurisdiction within the district, *Marin County*, expanded the provision by prohibiting the addition of any wood-burning device in home additions and remodels as well.[195]

The *South Coast AQMD* prohibits installation of permanent wood-burning devices, such as fireplaces and stoves, in new developments that are below 3,000 feet in elevation and have natural gas infrastructure within 150 feet of the property.[196] In the *Mendocino County AQMD*, installation of residential wood heaters is prohibited in major subdivisions.[197]

Some building codes and other policies governing new construction state expressly that wood heaters may not be the *sole or primary source of heat*. Wood-burning devices (other than "low-emitting devices") may not

[188] Mendocino County AQMD Regulation 4.1-400(e).
[189] Marin County (CA) Mun. Code §19.08.070.
[190] Placer County APCD Rule 225, §302.2.4.
[191] Mendocino County AQMD Regulation 4.1-400(c).
[192] Klamath County (OR) Ordinance 63.06 §406.100(3)(d); Bay Area AQMD Reg. 6, Rule 3 §6-3-305 (applies only to rental properties in areas with natural gas service); New York City Admin. Code §§24-149.2(b), 24-149.3(a).
[193] 18 AK Admin Code 50.077 (j).This restriction is applied within the nonattainment areas. Alaska DEC, Fairbanks PM2.5 Current Regulations (Summarized), https://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-regulations/.
[194] Bay Area AQMD Reg. 6, Rule 3 §§6-3-306, 6-3-230.
[195] Marin County (CA) Mun. Code § 10.08.090. As noted below, the code also requires the *removal* of non-compliant wood-burning heaters. Id. § 10.08.080.
[196] South Coast AQMD Rule 445, §§(d)(1), (i).
[197] Mendocino County AQMD Regulation 4.1-400(f).

be the sole source of heat in any new construction in the city of *Portola, California*.[198] *Washington* law requires the state building code to mandate an adequate source of heat other than a wood stove in new and substantially remodeled buildings located in nonattainment areas or designated urban growth areas.[199] *Alaska* similarly prohibits installing a wood-fired heating device as the primary or only heat source in new construction in the serious nonattainment area.[200]

Fireplace Installations

Some jurisdictions have enacted policies specifically restricting the installation of wood-burning fireplaces, which generally are not considered to be effective heaters, but which are used by millions of households for warmth and for aesthetic reasons.

Prohibiting New Installations. Rules of the *South Coast AQMD* ban new installations of wood-burning fireplaces.[201] In *Washoe County, Nevada*, the installation of additional wood-burning fireplaces is prohibited in existing residential or commercial properties.[202] State law and regulations in *Colorado* restrict the installation of new or remodeled wood-burning fireplaces in specified portions of counties in the Denver metropolitan area.[203] Similarly, *Arizona* law requires designated air quality areas of the state to restrict installation to fireplaces or wood stove inserts that meet EPA Phase II standards or the equivalent.[204]

Some regulations specifically restrict fireplace installations in new construction and remodeling projects. For example, within the *Mendocino County AQMD*, installation of an open wood-burning fireplace is prohibited in any new residential building or as part of a renovation.[205] In *Washoe County, Nevada* fireplace installation that is part of a permitted project is limited to one fireplace, and only on properties one acre or larger that are located outside a nonattainment area. During most property renovations and remodels, replacement of an existing fireplace is limited to an EPA-certified wood heater only.[206]

Requiring Lower-Emitting Fireplaces. *Utah l*aw restricts installation of fireplaces to those that are “EPA qualified.” This refers to fireplaces and fireplace retrofit devices that are "qualified" under EPA's Voluntary

[198] City of Portola (CA) Mun. Code § 15.10.030(B)(4), (5).
[199] Rev. Code Wa. § 70A.15.3520. Effective July 2020, the state building code incorporates this mandate. Wash. Admin. Code §§ 51-50-1203, 1204; 51-51-0303 (R303.10).
[200] 18 AK Admin Code 50.077 (j).
[201] South Coast AQMD Rule 445, §(d)(2); See also Placer County APCD Rule 225, §302.3.1.4 (allowing appliances determined to meet EPA’s emissions standards and approved in writing by the District.); Bay Area Air Quality Mgmt. Reg. 6, Rule 3 (restricting fireplace remodels costing over $15,000 and requiring a permit to use of gas-fueled, electric, or EPA-certified devices); San Joaquin Valley APCD Rule 4901, §5.1.2 (exception provided for retrofits of existing fireplace to a cleaner device).
[202] Installation of *any* fireplace is prohibited in properties located in a PM or CO non-attainment area. Washoe County (NV) Health District Regs. §040.051(C)(2)(b)(1),(2).
[203] Co. St. §25-7-407; 5 Co. Admin. Code §1001-6:VIII. The law allows only a fireplace insert, approved pellet-burning fireplace, or other clean burning devices that meet state emissions requirements for wood-burning stoves; if these jurisdictions have a building code, they must include a provision requiring compliance with this restriction.
[204] Az. Stat. §11-875. *See also* City of Cottonwood (AZ), Mun. Ord. § 8.56.050.
[205] Mendocino County AQMD Regulation 4.1-400(a).
[206] Washoe County (NV) Health District Regs. § 040.051(C)(2)(b)(1), (4).

Fireplace Program.[207] Similarly, the city of *Portola, California* prohibits issuance of a building permit to install a wood-burning fireplace unless it is an EPA-qualified or EPA-certified fireplace.[208]

The building code in *Laguna Beach, California* was amended to leverage the opportunity offered by major remodels of single-family homes; during such projects, the owner is *required to retrofit* any existing wood-burning fireplace to comply with EPA Phase II emission limits by using a qualified retrofit insert or by converting to gas or another approved device.[209]

Limits on Fireplace Remodels. Fireplace remodeling projects are another opportunity to address wood smoke emissions. The *San Joaquin Unified APCD* restricts the remodeling of any wood-burning fireplace or chimney that exceeds $15,000, requiring a local building permit to install a gas-fueled, electric, exempt, or EPA-certified wood-burning heater that meets federal emissions requirements at the time of installation.[210] The *Bay Area AQMD* has a similar policy.[211] In *Marin County, California*, the municipal code prohibits conversion of a gas fireplace to a wood-burning fireplace.[212]

The Installation Process

In adopting its 2015 wood heater rule, EPA "encourage[d] state, local, and tribal authorities to develop site-specific installation and operating requirements to help ensure healthy air for all."[213] The federal rule prohibits the installation of covered devices in a manner that is inconsistent with its label and with the owner's manual for the device.[214] Jurisdictions can reinforce this requirement in their own policies. For example, a *Maricopa County, Arizona* ordinance prohibits operating a residential wood-burning device unless it has been installed according to the instructions and restrictions specified by the manufacturer.[215]

> ***Requiring a permit for wood heater installations can help protect health and safety and reduce emissions.***

Jurisdictions can also put in place other measures – e.g., installation permits or requirements for professional installers – to help avoid installation mistakes that could increase emissions. (Some jurisdictions require permits to both install and *use* a wood-burning device; policies restricting use of devices are discussed in the following chapter.)

Permits for New Installations. The permitting process can be an important mechanism for implementing and enforcing restrictions on new installations. Permit inspections to ensure proper installation are also important for helping protect health and safety.

Many jurisdictions throughout the U.S. require permits for the installation of new or used wood-burning devices. Permits may be issued as part of a home construction or renovation project, or for projects involving

---

[207] Utah Admin. Code §R307-302-6. *See* U.S. EPA, List of Qualified Fireplaces and Fireplace Retrofit Devices, https://www.epa.gov/burnwise/list-qualified-fireplaces-and-fireplace-retrofit-devices.
[208] Portola (CA) Mun. Code § 15.10.030(A)(2).
[209] City of Laguna Beach (CA) Mun. Code tit. 14, ch. 14.86.012 (§§ 4.503.2); https://lagunabeachcity.net/civicax/filebank/blobdload.aspx?BlobID=10424.
[210] San Joaquin Valley APCD Rule 4901, §5.3.
[211] Bay Area AQMD Reg. 6, Rule 3 §307.
[212] Marin County (CA) Mun. Code §§19.08.070(c).
[213] 80 Fed. Reg. 13671, 13672 (3/16/2015).
[214] 40 CFR 60.538(e).
[215] Maricopa County (AZ) Air Pollution Control Regs., P-26 (Res. Burning Restrictions) §3(B).

only installation of the device. The requirement to obtain a permit is commonly incorporated into a jurisdiction's building code, but may also be established or reinforced in air quality laws and rules governing emissions of wood-burning devices.[216]

Permits are usually issued by the local building code officials.[217] In some cases, other agencies may be involved in permitting as well. In *Washoe County, Nevada* regulations prohibit any local government authority from issuing a building permit for installation without first obtaining receipt of a Certificate of Compliance from the Health District.[218] As noted earlier, Washoe County employs an additional oversight mechanism: an Affidavit of Sale is required for the installation of any wood-burning device.[219]

In *Missoula County, Montana* permits are required to install or use a new solid fuel burning device.[220] Within the city, the permitting process starts at the Health Department, which issues an air quality permit for installation of wood stoves and pellet stoves; a mechanical permit is then obtained from the City Building Division. Outside the city limits, the building division of the Missoula County Public Works Department handles all permitting. The Health Department has created an interactive map, which has proven to be a successful tool for letting people know what can be installed where, and where to go for a permit.[221]

Klamath County, Oregon requires submission of a Solid Fuel Burning Appliance Installation Supplement, including documentation of EPA certification, prior to final mechanical inspection. This requirement, along with a link to a list of certified woodstoves and fireplace inserts, is included prominently in the mechanical permit application.[222]

The *Mendocino County AQMD* has published a "Wood Burning Appliance Implementation Guide" for local planning staff, with recommendations on how to ensure compliance with district wood-burning regulations during pre-project meetings, plan check, and inspections.[223]

The building permit process can also be an opportunity to educate community residents generally on the importance of proper installation and operation of the device.[224]

---

[216] Widely used model building codes include a requirement for permitting. *See* Intl. Res. Code and Intl. Building Code, §§ 101.2, 104.2 (scope of coverage, permitting).
[217] See, e.g., Wa. Admin. Code 51-51-1001—1004, 51-50-2115; Or. Rev. Stat 468A.495; City of Cottonwood (AZ), Mun. Ord. §8.56.060; Klamath County (OR) Ordinance §63.06 §406.100(3)(a)(iii). *See also* City of Portola (CA) Mun. Code §15.10.030(A)(1)(barring any city agency from issuing a building permit to install an uncertified wood heater).
[218] Washoe County (NV) Health District Regs. §040.051(D)(1). Certificates may be issued for EPA-certified wood-burning devices or "low-emitting devices."
[219] Id. §§040.051(E)(1),(3).
[220] Missoula City-County Air Pollution Rules §9.202.
[221] Missoula City-County Dept. of Health, Wood Stove Installations: Installation Zones Map, https://www.missoulacounty.us/government/health/health-department/home-environment/air-quality/stove-installations; ELI Communications with Missoula Health Department Officials (Feb. 2021).
[222] Klamath County (OR), Mechanical Permit Application, http://klamathcounty.org/DocumentCenter/View/160/Mechanical-Permit-Application-PDF?bidId=.
[223] Mendocino County AQMD, Wood Burning Appliance Implementation Guide, http://www.co.mendocino.ca.us/aqmd/pdf_files/Woodstove%20Advisory.pdf
[224] *See, e.g*., City of Seattle (WA), Installation Requirements for Wood, Coal and Other Solid Fuel Burning Appliances, http://www.seattle.gov/DPD/Publications/CAM/cam416.pdf. EXS

Professional Installation. In addition to requiring permits, jurisdictions can help ensure compliance by establishing qualifications for those who install devices. *Alaska* requires professional installation of wood-burning devices by installers who have received specified third-party certification or the equivalent. Following each installation in a nonattainment area, the installer must submit to the state Department of Environmental Conservation a form verifying that the device was installed correctly.[225]

[225] 18 Ak. Admin. Code § 50.077(i); Alaska DEC, Vendors/Installers: Solid Fuel Fired Devices, https://dec.alaska.gov/air/burnwise/standards/#Vendors.

CHAPTER 3
Use of Existing Wood-Burning Devices

Policies that limit the transfer and installation of older wood-burning devices are important, however the timeline for those transactions may be years or decades in the future. In contrast, policies addressing how and when existing wood-burning devices may be *used* can result in immediate reduction in emissions and exposures. These policies can speed the transition to lower-emitting wood heaters or to non-wood alternatives. They can also help ensure that existing wood-burning devices are used properly, a key factor in lowering emissions.

This chapter discusses a variety of approaches to regulating the use of existing wood-burning devices:

- Prohibiting the use or requiring the removal of noncompliant devices. The first section describes the policies of four jurisdictions that take this approach: Alaska, Puget Sound Clean Air Agency (Washington), Lincoln County (Montana), and Marin County (California).

- Restricting the use of devices during periods of poor air quality (curtailment), an approach adopted by a number of jurisdictions that experience significant wood smoke pollution. This section describes the air pollution levels that trigger curtailment measures, the types of burning restrictions imposed, and mechanisms for enforcing curtailment restrictions.

- Setting performance standards for wood smoke emitted from devices. Independent of other restrictions on the use of wood-burning devices, standards governing the wood smoke that leaves a chimney can helpful in reducing emissions and addressing complaints about wood smoke emitted from neighboring properties. While opacity is a common standard, a number of jurisdictions have adopted a "visible emissions" standard that may be easier to implement. Public nuisance provisions are another tool to allow local agencies to respond to complaints involving serious wood smoke problems at the neighborhood level.

- Establishing required operating practices for devices. Many jurisdictions have rules requiring proper maintenance and operation of devices. The chapter ends by describing air pollution codes and property maintenance codes that include both general operating requirements and more specific restrictions on what may be burned, such as standards for the moisture content of firewood.

POLICY STRATEGY: PROHIBIT USE OR REQUIRE REMOVAL OF NONCOMPLIANT DEVICES

Chapter 2 described policies that help reduce emissions by requiring removal and/or destruction of noncompliant wood-burning devices when a home is transferred. Yet because many homes will not change ownership for years after a policy is enacted, some jurisdictions with significant air pollution problems have gone further.

This section describes key elements of the policies of four jurisdictions that require removal or ban the use of noncompliant devices that exist in a home, independent of the real estate transaction: *Alaska, Puget Sound Clean Air Agency (Washington)*, *Lincoln County (Montana)*, and *Marin County (California)*.[226]

Types of Devices Covered and Timing of the Requirement. In general, these policies apply to specified uncertified wood-burning devices, though Alaska's policy applies to both uncertified devices and to certified wood stoves that fail to meet an emissions limit.

Alaska law sets a deadline of December 31, 2024 for uncertified devices to be removed, if they have not already been removed through a real estate transaction. In addition, the state has established a rolling requirement for removal of certified devices over 25 years old if the device emits more than 2.0 g/hr.[227]

Puget Sound Clean Air Agency (CAA) rules require owners of uncertified wood stoves (or coal-only heaters) in the Tacoma-Pierce County $PM_{2.5}$ (former) nonattainment area to remove and dispose of the devices or render them permanently inoperable.[228] This action is authorized under state law, which allows the state or a local air authority to ban the use of uncertified wood stoves in $PM_{2.5}$ nonattainment or maintenance areas even in the absence of an Air Quality Episode or burn ban.[229]

Lincoln County has effectively banned the use of non-certified wood heaters, other than pellet stoves. County air regulations require an Operating Permit, issued by the Department of Health, to operate (or install) any solid fuel burning device, and a permit is only granted for pellet-burning devices and other devices that are certified as meeting EPA's Phase II emissions standards.[230] The requirements have also been adopted by the city of Libby, Montana, located within Lincoln County.[231]

Marin County prohibits the use of any non-EPA-certified wood heater (free standing or insert) on properties within unincorporated areas of the county and requires that noncompliant heaters be removed or rendered inoperable.[232]

---

[226] In Washington, state air quality laws are implemented largely through regional clean air agencies. Wash. Dept. of Ecology, Washington Clean Air Agencies, https://ecology.wa.gov/About-us/Our-role-in-the-community/Partnerships-committees/Clean-air-agencies.

[227] 18 Ak. Admin. Code §50.077(l),(n).

[228] Puget Sound CAA Reg. I, §13.07(a)(1),(2). The agency website explains that: "Hearth industry (wood stove) contractors can help you by either breaking off doors of a stove so they can't be reattached or by punching holes in the firebox so the stove can't be used again." Puget Sound CAA, Tacoma-Pierce County Wood Stove Rule FAQ, https://pscleanair.gov/Faq.aspx?QID=198.

[229] Rev. Code Wash. §70a.15.3600; Wa. Admin. Code §173-433-155.

[230] Lincoln County (MT) Air Pollution Regs. §§75.1.204(1), .205, .203(5),(6).

[231] City of Libby (MT) Mun. Code §§8.12.070 -.140.

[232] Marin County (CA) Mun. Code §19.08.100. The ordinance defines "EPA certified" to mean that the device meets the EPA standards in effect at the time of installation. Id. §19.08.030(3).

Marin County and the Puget Sound CAA offer exemptions for households with no other source of adequate heat, and Alaska considers requests for temporary waivers on a case-by-case basis considering financial hardship, technical feasibility, and potential impact to populations sensitive to particulate matter exposure.[233]

Implementation. As noted above, Lincoln County requires an Operating Permit. The Department of Health may revoke a permit for noncompliance and may initiate enforcement measures outlined in the air rules. A first Notice of Violation is considered a warning and must include "educational and compliance information on air pollution regulations"; subsequent violations are considered misdemeanors subject to fines.[234] Puget Sound CAA rules don't require a permit, but they do require that documentation of compliance be provided to the agency within 30 days of removal or rendering the device inoperable.[235]

The requirement for a permit or for documentation allows local officials who observe smoke from chimneys to determine whether there is a permit on record for the location. On its website, the Puget Sound CAA describes how it will use periodic inspections to enforce the requirement:

> "*We will enforce the rule the way we've enforced our air quality burn ban and excess smoke rules for years: by looking for smoke. Uncertified wood stoves produce a lot more smoke than a certified stove. If you have illegal smoke, we'll be checking in with you to find out more about your stove....If the agency sees smoke and issues a Notice of Violation, the device owner would need to show that the device is certified and that opacity is within legal limits."*[236]

The availability of financial assistance is an important adjunct to enforcing requirements to remove noncompliant devices, and each of the jurisdictions described in this section has carried out such programs. Lincoln County and the City of Libby, e.g., are well known for their extensive wood stove changeout program undertaken prior to implementing their removal requirement, in order to help families make the switch to certified devices.

Financial assistance policies and programs are discussed in Chapter 5.

[233] Puget Sound CAA Reg. I, §13.07(a)(3); Marin County (CA) Mun. Code §19.08.100 (also provides a 30-day exemption for a non-functional heater); Ak. Dept. of Envtl. Cons., Real Estate Requirements – Fairbanks North Star Borough PM2.5 Nonattainment Area, https://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-real-estate/#realtors.
[234] Lincoln County (MT) Air Pollution Regs. §§75.1.205(4), .207.
[235] Puget Sound CAA Reg. I, §13.07(a)(4).
[236] Puget Sound CAA, Tacoma Pierce County Wood Stove Rule FAQ, https://pscleanair.gov/Faq.aspx?QID=198.

POLICY STRATEGY: LIMIT USE OF DEVICES WHEN AIR QUALITY IS IMPAIRED (CURTAILMENT)

One of the most common policy strategies for reducing emissions in areas heavily impacted by wood smoke is to restrict wood burning during periods when air quality is impaired. These restricted periods are referred to as curtailment or no-burn periods. A 2015 study of the curtailment rules in the San Joaquin Valley APCD found that the rules were effective in reducing wintertime ambient $PM_{2.5}$ levels and decreasing hospital admissions for heart disease among people aged 65 years and older.[237]

Curtailment policies require agencies to identify when air quality is impaired, notify the public and initiate a curtailment period, and oversee restrictions on how people use wood-burning devices in their homes during the curtailment period. Thus, while important for minimizing emissions when ambient PM levels are elevated, this type of policy may require considerable resources to implement and enforce.

Curtailment policies are commonly employed as a control measure in PM nonattainment and maintenance areas, but have been established outside those areas as well. For example, *Multnomah County, Oregon*, where wood smoke is one of the largest sources of ambient $PM_{2.5}$, adopted a curtailment ordinance in 2018 to address the risks posed by winter wood burning.[238]

State policies may set the criteria for mandatory curtailment, while authorizing state and/or local agencies to implement those criteria.[239] State policies may also allow local governments to establish their own curtailment policies, provided they are at least as strict as state requirements. *Salt Lake County, Utah* and *Klamath County, Oregon* are examples of local jurisdictions with policies that exceed state requirements.[240]

In addition, the federal government has authority to call burn bans in tribal jurisdictions, or to delegate implementation of that authority to a tribe, pursuant to the Federal Air Rules for Reservations (FARR).[241] The rules, which apply to federally recognized reservations in Idaho, Washington, and Oregon, include provisions for restricting burning during periods of poor air quality.[242] As noted in Part One, the FARR is applied to individual tribes through Federal Implementation Plans promulgated by EPA for each tribe, and some tribes

[237] P. Yap & C. Garcia, Effectiveness of Residential Wood Burning Regulations on Decreasing PM & Hospitalizations in the San Joaquin Valley Air Basin, *Amer. J. of Public Health*. V. 105, No. 4 (Apr. 2015), https://ajph.aphapublications.org/doi/pdf/10.2105/AJPH.2014.302360.

[238] Multnomah County (OR) Mun. Code §21.454; Multnomah County, Wood Smoke Curtailment, 2018-2019, https://multco.us/file/84458/download. See generally Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 22 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf.

[239] See, e.g., Rev. Code Wash. §§70A.15.3580 (1)(b),(c); Wash. Admin. Code §173-433-140 (state practice is to call burn bans in counties with no local clean air agency); 5 Co. Admin. Code §1001-6:VII (state enforces in areas without their own ordinance); Or. Admin Code §340-262-0800 (state implements where locality lacks ordinance and implementation program); Az. Stat. §11-871 (requiring certain counties to develop and enforce a curtailment ordinance). Alaska enforces the state curtailment policy in Fairbanks following a local referendum in 2018 removing the Borough's authority to regulate home heating. Fairbanks North Star Borough Code §21.28.070(B).

[240] Salt Lake County (UT) Health Dept. Reg. #35, §4.1.2 (prohibiting burning on days designated by the state as voluntary action days); Klamath County (OR) Ordinance 63.06 §406.005(1) ($PM_{2.5}$ threshold of 30 ug/m^3 for triggering Red Air Quality Advisory Period).

[241] 40 CFR 49.121 et seq.

[242] 40 CFR 49.137(c)(4)(iii); U.S. EPA, About the Federal Air Rules for Reservations (FARR), https://www.epa.gov/farr/about-federal-air-rules-reservations-farr#what.

implement the federal provisions through delegation agreements with EPA.[243]

Curtailment policies are often highly detailed. This section provides only a short overview of how policies incorporate certain key elements:

- The air pollution levels that trigger a curtailment period;
- The types of burning restrictions imposed and exemptions that are allowed; and
- The key implementation and enforcement mechanisms.

While some policies include voluntary curtailment provisions, this section focuses on mandatory measures.

Air Pollution Trigger Levels

In general, curtailment periods are triggered when specified levels of air pollutants have been reached. They may also be triggered when pollutant levels are expected to be reached within a certain period of time, given meteorological and other conditions, and policies may specify how the implementing agency is to make that determination.[244]

Policies generally establish different *stages* of curtailment, with increased levels of restrictions tied to increased ambient PM levels, as set forth in the law or regulations. A number of policies trigger certain mandatory burn restrictions at levels below the federal 24-hour $PM_{2.5}$ standard of 35 u/m^3.[245] Often, curtailment policies set different pollutant thresholds for nonattainment areas compared to other parts of the jurisdiction.[246] While some curtailment policies authorize restrictions throughout the year, others allow curtailment only in the winter months when residential wood burning has the greatest impact on air quality. The *Bay Area AQMD* recently extended its authority to issue burn restrictions from winter only to year round, whenever a Spare the Air Alert is in effect due to high $PM_{2.5}$ levels.[247]

Types of Restrictions and Exemptions

Burn Bans and Restrictions on Types of Devices. Curtailment policies generally establish that during a designated curtailment period (1) only certain types of devices may be used – e.g., EPA-certified wood heaters, or (2) no wood-burning devices may be used.

---

[243] See, e.g., 71 FR 60852 (partial delegation of administrative authority to the Confederated Tribes of the Umatilla Indian Reservation); 81 FR 12825 (partial delegation of administrative authority to the Confederated Tribes of the Colville Reservation); 70 FR 54638 (partial delegation of administrative authority to the Nez Perce Tribe); 73 Fed. Reg. 61742 (partial delegation of administrative authority to the Coeur D'Alene Reservation). *See also* U.S. EPA, Burn Bans on Indian Reservations in ID, OR, and WA, https://www.epa.gov/farr/burn-bans-indian-reservations-id-or-and-wa#allowed-burning.

[244] See, e.g., City of Portola (CA) Mun. Code §15.10.060(4),(5).

[245] See, e.g., 18 Ak. Admin. Code §50.246; Rev. Code Wash. §70A.15.3580 (1)(b), (c). Or. Admin. Code §340-262-0800; San Joaquin Valley APCD Rule 4901, §§5.7.1, 5.7.2; South Coast AQMD Rule 445, §§(e),(f); Maricopa County (AZ) Air Pollution Control Regs., P-26 (Res. Burning Restrictions) §3(D)(1)(c); City of Portola (CA) Mun. Code §§15.10.060(A)(4), 15.10.070); Lincoln County (MT) Air Pollution Regs. §75.1.206; Swinomish Tribal Code §19-02.100(B). The FARR authorizes EPA to declare a burn ban (for *outdoor* burning) whenever the agency "determines that air quality levels have exceeded, or are expected to exceed, 75% of any national ambient air quality standard for particulate matter, and these levels are projected to continue or reoccur over at least the next 24 hours."40 CFR 49.131(d)(2).

[246] See, e.g., 18 Ak. Admin. Code §50.246; Alaska DEC, Episode Information, https://dec.alaska.gov/air/burnwise/episodes/. *See also* Wash. Admin. Code § 173-433-150; Rev. Code Wash. §§70A.15.3580(1)(b),(c).

[247] Bay Area AQMD, Wood Smoke Pollution, https://www.baaqmd.gov/rules-and-compliance/wood-smoke.

When the state of *Colorado* calls a high-pollution day, jurisdictions subject to the burn ban may only use certified wood-burning devices that meet EPA's Step 2 emissions standards.[248] The city of *Chico, California* similarly prohibits operation of wood-burning devices during a curtailment period, with the exception of an EPA Phase II certified wood-burning device, including a pellet stove.[249]

Alaska restricts the use of *all* solid fuel burning devices in the state's $PM_{2.5}$ nonattainment areas during Air Alerts.[250] Regulations in *Texas* prohibit the operation of any solid fuel heating device in the City of El Paso during a period when National Weather Service data indicates that an atmospheric stagnation condition exists or is predicted to exist.[251]

A number of state and local policies ban the use of wood-burning devices during designated air quality episodes.

Washington state law and regulations delineate stages of impaired air quality that trigger different minimum requirements. During Stage 1 of an Impaired Air Quality Burn Ban, operation of a solid fuel burning device is prohibited unless it is an EPA or Oregon Phase II certified wood stove or pellet stove. During Stage 2 and during declared Air Pollution Episodes, no solid fuel burning devices may be used.[252] Other jurisdictions have similar staged restrictions.[253]

The *Swinomish Indian Tribal Community* has adopted burn ban rules as part of its Tribal Implementation Plan.[254] The rules authorize the tribe's Department of Planning and Community Development to ban *open* burning during episodes or periods of impaired air quality. However, the code also authorizes the department to exercise discretion, based on the severity of air quality conditions, to prohibit the use of woodstoves, except in homes where woodstoves are the primary heating source.[255] Under the Federal Air Rules for Reservations, if EPA calls a curtailment period for tribes in the northwestern U.S., people are "requested" take voluntary actions to reduce emissions, including "refrain[ing] from using their wood-stoves and fireplaces unless they are their sole source of heat," but only open burning is prohibited. During these episodes, EPA may also "issue an order to any air pollution source requiring such source to curtail or eliminate the emissions." [256]

Other Conditions Placed on Burning During Curtailment Periods. Some jurisdictions that allow use of wood-burning devices during curtailment periods impose restrictions on their use.

One approach is to place limits on *visible emissions* or on the *opacity* (a quantitative measure of opaqueness) of smoke from wood burning. (The next section describes opacity regulations in more detail.) In *Lincoln County, Montana*, for example, no person operating a solid fuel burning device that is permitted for use

[248] 5 Co. Admin. Code §§1001-6:VII(E), II(A)(3), III(G)(2). See also South Coast AQMD AQMD Rule 445, §§(e),(f) (limited to "wood burning season"); Portola (CA) Mun. Code §§15.10.060, 15.10.070 (Nov.-Feb, and contingency measure expands to Sept.–April).
[249] City of Chico (CA) Mun. Code §§ 8.32.030, .040.
[250] 18 Ak. Admin. Code §50.075; Ak. Dept, of Envtl. Cons., Episode Information, https://dec.alaska.gov/air/burnwise/episodes/.
[251] 30 Tx. Admin. Code §111.111(c).
[252] Wash. Admin. Code §173-433-150; Rev. Code Wash. §70A.15.3580.
[253] See, e.g., Or. Admin. Code §340-262-0800; San Joaquin Valley Unified APCD Rule 4901, §§5.7.1, 5.7.2.
[254] 40 CFR 49.10956(l). As a result, the FIP for the Snohomish Tribe does not include the FARR's open burning provisions.
[255] Swinomish Tribal Code §19-02.100(G).
[256] 40 CFR 49.137(c)(3),(4). See generally, U.S. EPA, Burn Bans on Indian Reservations in ID, OR, and WA, https://www.epa.gov/farr/burn-bans-indian-reservations-id-or-and-wa#allowed-burning.

during an Alert may cause or allow the discharge of visible emissions greater than 10 percent opacity.[257] In *Albuquerque/Bernalillo County, New Mexico,* certified devices may operate during a no-burn period provided that there are no visible emissions after a 20-minute period following startup or refueling.[258] In *Maricopa County, Arizona,* those obtaining an exemption from curtailment restrictions may operate a wood-burning device if "no visible emissions to the atmosphere are produced after 20 consecutive minutes immediately following an ignition of, or a refueling of, the device."[259]

Some jurisdictions that allow approved devices to be used during curtailment periods condition their use on the device being *maintained and operated properly,* in accordance with manufacturer instructions. The *Bay Area AQMD* requires "documentation that the device is operated according to manufacturer's specifications."[260] In the *San Joaquin Valley APCD*, approved wood heaters must be maintained and operated per manufacturer's instructions and registered with the district for use during Level One curtailment periods; registration requires proof of inspection by a District Registered Wood Burning Heater Professional to verify that the device is maintained pursuant to manufacturer specifications.[261] *Klamath County, Oregon*, also has required yearly safety and efficiency inspections in certain cases where residents apply for an exemption from mandatory curtailment periods.[262]

Exemptions. It is common for curtailment policies to allow individuals to apply for and receive an exemption from curtailment restrictions in certain circumstances. Most policies allow a waiver to be granted for economic hardship and may establish income limits or similar criteria. The city of *Chico, California* allows a waiver if the monthly household income is 80 percent or less of the area median, while *Missoula, Montana* makes exemptions available to those who qualify for energy assistance under the county's Low Income Energy Assistance Program.[263]

Another common exemption is for households where the wood-burning device is the sole source of heat.[264] Some jurisdictions limit when this exemption may be granted. Rules of the *Bay Area AQMD* only grant sole source exemptions for EPA-certified devices.[265] In *Missoula, Montana*, sole source exemptions within the Air Stagnation Zone are only available for pellet stoves that emit less than 1.0 g/hr.[266] *Alaska's* criteria for considering exemptions from burning restrictions are unusual in including potential impacts to schools, child care, and other "locations with populations sensitive to exposure to PM-2.5."[267]

---

[257] This requirement does not apply during the building of a new fire as specified in the regulations. Lincoln County (MT) Air Pollution Regs. §§75.1.204(4). Policies more commonly set an opacity limit of 20%. *See, e.g.,* City of Chico (CA) Mun. Code §8.32.040(A); Ak. Admin. Code §50.075.

[258] N.M. Admin. Code §20.11.22.15(A). See also Missoula (MT) City-County Air Pollution Rules §§9.302(1)-(2) (no visible emissions during Air Pollution Alerts except for permitted devices, which may not exceed 20% opacity).

[259] Maricopa County (AZ) Air Pollution Control Regs., P-26 §3(A).

[260] Bay Area AQMD Reg. 6, Rule 3 §404. *See also,* San Joaquin Valley Unified Air Pollution Control District, Rule 4901, §5.7.1.3; City of Portola (CA) Mun. Code §15.10.060(A)(3).

[261] San Joaquin Valley Unified APCD Rule 4901, §§ 5.7.1.3, 5.9.2.1., 5.10.

[262] Klamath County Public Health, Request for Exemption 2018-2019, http://www.klamathcounty.org/DocumentCenter/View/21803/Exemption-Application-2018-2019-revised-with-deadlinepdf.

[263] City of Chico (CA) Mun. Code §8.32.050; Missoula (MT) City-County Air Pollution Rules §9-207.

[264] See, e.g., Wash. Admin. Code §173-433-150 (no other adequate source of heat); 5 Co. Admin. Code §1001-6:VII (wood is primary source of heat).

[265] Bay Area AQMD Reg. 6, Rule 3 §110. Rental properties may not receive this exemption. Id. §110.

[266] Missoula (MT) City-County Air Pollution Rules §§9.206.

[267] Ak. Admin. Code §50.075(d).

Implementation and Enforcement

Enforcement of curtailment restrictions may occur both proactively and in response to complaints. The *Puget Sound CAA* provides a burn ban hotline and conducts patrols in high air pollution areas.[268] The state of *Colorado* provides a recorded indoor burning hotline for complaints and general questions.[269]

One way to implement and enforce curtailment restrictions and exemptions is by requiring *registration* of exempted devices. The *San Joaquin APCD* allows use of EPA-certified wood heaters and exempt pellet heaters during Level One curtailment periods, but only if the device is first registered. Those applying for registration must pay a fee and submit documentation that the device is eligible, and the district has the right of entry to inspect any registered device.[270]

Alaska has had a voluntary device registration program in place for years, and in 2020 the state made registration mandatory in the Fairbanks North Star Borough nonattainment area when applying for a waiver of burning restrictions. Registration is also required within the area when selling/conveying a device, in connection with the sale or lease of a property, in connection with a related enforcement action, and when participating in voluntary state wood stove programs. The state has created a one-page form that includes basic information about the device and the reason for registration, and provides for electronic submission through an agency web page.[271]

Jurisdictions can also offer targeted financial assistance to help households comply with burning restrictions during curtailment periods. *Lincoln County, Montana* instituted an extensive financial assistance program before its rules took effect. For a period of time, the county operated an electric heater loan program during curtailment periods for people who have only wood heat in their homes. The county requires a permit/registration in order to use approved devices during curtailment periods, and the registration form allowed people to sign up for the electric heater loan service.[272] In past years, the Lane Electric Cooperative has covered the cost of running an electric heat pump on poor air quality days for lower-income households in Oakridge, Oregon.[273] Chapter 5 describes a broader range of financial assistance programs for reducing wood smoke pollutant emissions.

[268] Puget Sound CAA et al., Burn Ban Enforcement Has Begun, http://www.airsafepiercecounty.org/burn-bans (accessed 1/8/21).
[269] Col. Dept. of Public Health & Envt., Indoor Burning Restrictions, https://cdphe.colorado.gov/indoor-burning-restrictions.
[270] San Joaquin Valley Unified APCD Rule 4901, §§5.9.1, 5.9.2, 5.13 See also Bay Area AQMD Reg. 6, Rule 3 §6-3-404; City of Portola (CA) Mun. Code §15.10.060(A).
[271] 18 Ak. Admin. Code §50.077(h)(i); Ak. Dept. of Envtl. Cons., Wood-fired Heating Device Registration, https://dec.alaska.gov/air/anpms/communities/device-registration/.
[272] Lincoln County (MT) Environmental Health, Wood Stove Registration and Heater Loan Application, http://www.lincolncountymt.us/images/departments/environmental_health/pdf/air_quality/stoveregistration-heaterloan.pdf (accessed: 2/23/21).
[273] See Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 32 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf. The utility has also provided grants and loans for the purchase of heat pumps. Id. at 34.

POLICY STRATEGY: IMPLEMENT PERFORMANCE STANDARDS FOR WOOD SMOKE EMISSIONS

In addition to regulating the transfer, installation, and use of wood-burning devices, policies can establish performance standards that apply to the smoke being released from a chimney during wood burning. EPA-certified wood heaters, if operated properly, burn with little or no visible emissions after the initial start-up of the heater.[274] Increased visible emissions may result from older wood heaters, or from any cordwood device that is not being used properly.[275]

Standards that apply to the smoke emitted from a device can be used in two important ways: first, to help determine compliance with other measures, such as curtailment periods or requirements to properly operate and maintain devices; and second, as a tool for addressing the health risks to people directly affected by wood smoke emissions. Many jurisdictions around the country are called on to handle complaints about wood smoke coming from a neighboring property.

This section discusses performance standards that have been established through two types of policies:

- Air quality limits – framed in terms of opacity, visible emissions, or harmful impacts; and
- Nuisance standards – framed in general terms or with specific reference to air pollution or wood smoke.

As discussed in the last part of the section, enforcing such performance standards poses an ongoing challenge.

Air Quality Standards: Opacity, Visible Emissions, and Impacts

Opacity. Opacity measures how opaque a smoke plume is, or how much the background is blocked by smoke. Many jurisdictions throughout the U.S. have laws that establish opacity limits for air emissions. Some jurisdictions – including many of those reviewed for this report – establish opacity limits specifically for solid fuel burning devices. As noted earlier in the report, opacity limits may be set for certain periods of time (e.g., during curtailment periods), and they may be used to facilitate compliance with other limitations on burning. They also may be established as a general standard for addressing localized wood smoke impacts. For example, rules of the *Puget Sound CAA* establish that: "Smoke visible from a chimney, flue or exhaust duct in excess of the opacity standard shall constitute prima facie evidence of unlawful operation of a solid fuel burning device" with certain exceptions. [276]

Even in jurisdictions that have not set opacity limits specifically for wood-burning devices, there may be general opacity limits for stationary air pollution sources.[277] Though often geared more toward industrial and

[274] Cal. Air Resources Bd., Wood Burning Handbook, https://ww2.arb.ca.gov/resources/documents/woodburning-handbook ("a properly burning fire should give off only a thin wisp of white steam").
[275] See U.S. EPA, Frequent Questions about Wood-Burning Appliances, https://www.epa.gov/burnwise/frequent-questions-about-wood-burning-appliances; Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 31 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf.
[276] Puget Sound CAA Reg. I, §13.03.
[277] EPA has established opacity limits as part of its New Source Performance Standards (NSPS), but has not included opacity limits in its NSPS rule for wood heaters.

commercial sources, in some cases the provisions are framed broadly enough to apply to residential wood-burning sources as well.[278]

Quantitative Opacity Limits. Most opacity provisions include similar numerical standards and measurement methods. Opacity limits are commonly set as a percentage that indicates how much of the view is obscured by the smoke plume. (Some jurisdictions also use the 1-5 numerical system of an earlier measure, the Ringelmann Chart.) Many jurisdictions set a maximum opacity of 20 percent.[279] This is considered a standard that can usually be met if recommended burning practices are followed.[280] The limit is commonly described as an average over a stated number of minutes – for example:

- The *Federal Air Rules for Reservations*, which apply to federally recognized reservations in Idaho, Washington, and Oregon include a general opacity standard: "visible emissions from an air pollution source must not exceed 20 percent opacity, averaged over any consecutive six-minute period."[281]

- *Washington* state regulations prohibit emission of a smoke plume from any solid fuel burning device exceeding an average of 20 percent opacity for six consecutive minutes in any one-hour period, and this opacity standard and related measures preempt other state agencies and local governments from establishing a different standard.[282]

- *Rhode Island's* general air quality rules prohibit anyone from emitting "into the atmosphere from *any source* any air contaminant for a period or periods aggregating more than three minutes in any one hour which is greater than or equal to 20 percent opacity."[283] Similarly, air quality rules for *Maricopa County, Arizona* prohibit discharge into the ambient air from any single source of emissions in excess of 20 percent opacity for a total of more than three minutes in any 60-minute period.[284]

Some opacity standards provide an explicit exemption for start-up and refueling of a device. *Utah* law prohibits visible emissions from solid fuel burning devices from exceeding 20 percent opacity, except for an

[278] Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 31 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf. On the other hand, some state laws expressly exempt residential sources or wood-burning devices from general opacity limits. See, e.g., 10 Missouri Admin. Code §10-6.220 (excepting wood burning stoves or fireplaces used for heating); Mont. Admin. Rules §17.8.304 (excepting residential solid fuel combustion devices).

[279] Some jurisdictions have higher opacity limits. See, e.g., Missoula (MT) City-County Air Pollution Rules §9.104 (40% opacity for solid fuel burning devices); 11 Miss. Admin. Code Pt. 2, R. 1.3B (40% opacity from any point source or emissions); N.M. Admin. Code §20.11.22.15(B) (Albuquerque/Bernalillo County rules setting 30% opacity limit for wood burning devices when it is not a curtailment period).

[280] See, e.g., Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 31 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf ("A well-controlled wood-burning appliance will have less than 20 percent opacity and typically no visible emissions.").

[281] Indoor residential wood-burning devices are not expressly exempted. 40 CFR 49.124. As noted earlier, the standard is made applicable to tribes through the Federal Implementation Plans promulgated by EPA, and some tribes have been delegated authority to implement the requirements. 40 CFR Pt. 49, Subpt. M; see supra note 78.

[282] Rev. Code Wash. §70A.15.3570; Wash. Admin. Code §173-433-110 (also requiring the state to establish a statewide opacity level of 10% "for purposes of public education").

[283] 250 R.I. Admin. Code §120-05-1.6 (emphasis added). See also, e.g., 7 Del. Admin. Code §1114-2.0, 6 N.Y. Code Rules & Regs. §211.2.

[284] Maricopa County (AZ) Air Poll. Control Reg. III, R. 300, §300.

initial 15-minute start up and for 15 minutes in any three-hour period for refueling.[285] Rules of the *Bay Area AQMD* exempt the startup of a new fire (for up to 20 consecutive minutes in any consecutive four-hour period) from the general limit of 20 percent opacity.[286] In *Washoe County, Nevada*, emissions created during a 15-minute start-up period are exempt from the 20 percent opacity limit for wood burning.[287]

Measurement of Opacity. The measurement standard commonly required for determining compliance with opacity limits is EPA's Method 9, "Visual Determination of the Opacity of Emissions from Stationary Sources." Under this standard, opacity is determined visually by a qualified observer. EPA sets forth criteria for training and certification of observers, as well as the procedures that must be followed in the field.[288] Method 9 involves recording observations of the opacity of plumes at 15-second intervals for a period determined by the standard (e.g., six minutes). The method does not require special measurement devices or equipment, but observers must have a clear view of the emissions at a proper angle and must have adequate lighting and contrast between the plume and background. The sun is implied as the light source and should be at the observer's back.[289]

Visible Emissions*.* Some jurisdictions have established prohibitions on "visible emissions" from wood-burning devices or from air pollution sources more generally, independent of opacity.

Standard for Visible Emissions. The previous section of the report described examples of visible emissions standards during curtailment periods. The following examples apply the standard more generally and include two key elements: (1) visible emissions that (2) cross a property line.

- Prior to 2018, the *Fairbanks North Star Borough* in Alaska implemented a visible emissions standard that was separate from the Borough's 20 percent opacity limit:

  "No person shall cause or emit particulate emissions from a nonmobile source to impact the resident(s) of a neighboring property through the creation of an emissions plume that: (1) Crosses a property line; (2) Is observable using EPA Method 22;....and (3) Is 25 µg/m^3 greater than the surrounding immediate vicinity background $PM_{2.5}$ level...[within] an area measured 1,200 feet in all directions from the boundaries of the emitting property."[290]

- Following removal of the Borough's authority to regulate wood heaters via a citizen ballot initiative in 2018, *Alaska* state regulations were revised to include a provision similar to the Borough measure, though formulated differently. Alaska regulations set a 20 percent opacity limit for solid fuel heating

[285] Utah Admin. Code §R307-302-5. See also, e.g., 6 NY Code Rules & Regs. §211.2 (20% opacity limit for air pollution sources except for one continuous six-minute period per hour of not more than 57% opacity).
[286] Bay Area AQMD Reg. 6, Rule 3 §308.
[287] Washoe County (NV) Health District Regs. §040.051(C)(3). See also, e.g., Lincoln County (MT) Air Pollution Regs. §75.1.204 (exempting from 20% opacity limit the building of a new fire, for a period or periods aggregating no more than 20 minutes in any four-hour period); Placer County APCD Rule 225, §304.2 (exempting from 20% opacity limit a 30-minute start-up or shut-down period).
[288] 40 CFR Pt. 60, Appendix A; U.S. EPA, Visible Emissions Field Manual EPA Methods 9 and 22 (1993), https://www3.epa.gov/ttnemc01/methods/VEFieldManual.pdf.
[289] U.S. EPA, Visible Emissions Field Manual EPA Methods 9 and 22 (1993), https://www3.epa.gov/ttnemc01/methods/VEFieldManual.pdf.
[290] Fairbanks North Star Borough Code §21.28.030 (on file with ELI). This rule was deleted from the municipal code following a 2018 citizen referendum that barred the Borough from enforcing the rule and from regulating wood heaters in any way. Prop. 4, the Home Heating Reclamation Act; Fairbanks North Star Borough Code §21.28.070(B).

devices that applies during the winter season in the state's serious nonattainment areas.[291] In addition to the opacity standard, the law includes this prohibition: Devices may not be operated in a manner that causes "visible emissions...to cross property lines."[292] Thus, in nonattainment areas, visible smoke may not cross onto a neighboring property.

- *Connecticut* is an example of a state that has a visible emissions standard applicable to air pollution sources generally. The state's air rules prohibit the emission of particulate matter that causes a nuisance and provides more specifically that "no person shall cause or allow the emission of visible particulate matter beyond the legal boundary of the property...that either (A) remains near ground level beyond such property boundary; or (B) diminishes the health, safety or enjoyment of people using a building or structure located beyond the property boundary.[293]

Some policies address local wood smoke impacts by prohibiting "visible emissions" from crossing property lines.

- State air quality rules in New York and Maine include a visible emission requirement that applies specifically to outdoor wood boilers, but could be adapted for regulating smoke from indoor wood heaters as well. *New York's* rule prohibits emissions that are "[i]njurious to human, plant or animal life or to property, or which unreasonably interferes with the comfortable enjoyment of life or property" and states expressly that the requirement applies to situations that cause "a visible plume migrating from an outdoor wood boiler and contacting a building on an adjacent property."[294] *Maine's* rule states: "No person shall operate an outdoor wood boiler or an outdoor pellet boiler, that produces visible emissions, measured as any opacity totaling twelve minutes in any hour, that cross onto any land or buildings immediately adjacent to a dwelling or commercial building not owned by the owner of the outdoor wood boiler."[295] The rule specifies that opacity is to be measured using EPA Method 22.

Measurement of Visible Emissions - EPA Method 22. EPA has established a standard that could be used to verify compliance with a prohibition on visible emissions – Method 22, Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares.[296] Method 22 is a "qualitative technique that checks only the presence or absence of visible emissions" and does not require the measurement of opacity levels. Method 22 does not require that the sun be the light source or that a light source be located behind the observer. More importantly, Method 22 does not require that the observer be certified; the observer must be knowledgeable about the general procedures of the rule, which may be accomplished through self-training by reading materials referenced in the rule.[297] Thus, a standard for visible emissions could allow a member of the public to document compliance – e.g., by using their phone to record a video with a date stamp.

---

[291] 18 Ak. Admin. Code §50.075(f) (emissions may not exceed 20% opacity for more than 6 minutes in any hour; opacity must be less than 50% during the first 15 minutes after initial firing).
[292] 18 Ak. Admin. Code §50.075(f).
[293] Ct. Admin. Code §22a-174-18(c)(2).
[294] 6 N.Y. Code Rules & Regs. §247.3(c).
[295] 06-96 Me. Rules ch. 150, §5.
[296] 40 CFR Pt. 60, Appendix A
[297] Method 22 §2.3; 40 CFR Pt. 60, Appendix A. EPA also provides a guidance document with instructions on making and recording observations. U.S. EPA, EPA Method 22 – Visual Determination of Fugitive Emissions, available at: https://www.epa.gov/emc/method-22-visual-determination-fugitive-emissions.

Impacts from Wood Smoke Emissions. Some air pollution laws and regulations establish a broad prohibition on air emissions that cause injury or harm. Such provisions might provide air agencies a basis for taking action to address wood smoke emissions independent of opacity limits or other restrictions on the use of wood-burning devices. For example, as stated in *New York's* air pollution rules:

> "*No person shall cause or allow emissions of air contaminants to the outdoor atmosphere of such quantity, characteristic or duration which are injurious to human, plant or animal life or to property, or which unreasonably interfere with the comfortable enjoyment of life or property.* Notwithstanding the existence of specific air quality standards or emission limits*, this prohibition applies, but is not limited to, any particulate, fume, gas, mist, odor, smoke, vapor, pollen, toxic or deleterious emission, either alone or in combination with others*."[298]

Rules adopted by *Washington* state include a similarly broad standard specifically for solid fuel burning devices: "No person shall cause or permit the emission of any air contaminant from an identifiable solid fuel burning device, including any air contaminant whose emission is not otherwise prohibited by this chapter, if the air contaminant emission causes detriment to the health, safety, or welfare of a person, plant or animal, or causes damage to property or business." Additionally, if the device causes odors that may interfere with another's use or enjoyment of their property, the device owner must use "recognized good practice and procedures to reduce these odors to a reasonable minimum."[299]

Maine's rules for outdoor wood boilers, in addition to setting a visible emissions standard, state broadly: "No person shall operate an outdoor wood boiler or an outdoor pellet boiler, in such a manner as to create a nuisance," and define nuisance as "emission of air contaminants to the outdoor atmosphere of such quantity, characteristic or duration that may be injurious to human, plant or animal life or to property, or that unreasonably interferes with the comfortable enjoyment of life or property."[300]

Nuisance Standards

Even absent an opacity limit or other air quality standard, wood heater emissions might be impermissible if they cause harm that is prohibited under an applicable nuisance provision.

There are two kinds of nuisances – public and private. Private nuisances are actions (or omissions) that invade another person's use and enjoyment of their property and are enforced by the affected party.[301] A public nuisance is an "unreasonable interference with a right common to the general public."[302] An important difference is that public nuisances may be enforced by government agencies (and, in some jurisdictions, by affected individuals as well). Enforcement of private nuisance standards requires legal action by those impacted, and thus would not be a viable option for many people.

In contrast to laws and regulations creating specific restrictions on wood burning, public nuisance provisions establish a general prohibition or standard that may be used by the jurisdiction to act in specific cases of

[298] 6 N.Y. Code Rules & Regs. §211.1 (emphasis added). See also, e.g., Northern Sierra (CA) Air Quality Mgmt. District Rule 205 ("A person shall not discharge from any source whatsoever such quantities of air contaminants ... which cause injury, detriment, nuisance or annoyance to any considerable number of persons, or to the public, or which endanger the comfort, repose, health or safety of any such persons, or the public...); New York City Admin. Code §24-141.
[299] Wash. Admin. Code §173-433-130.
[300] 06-96 Me. Rules ch. 150 §§5(B), 2(F).
[301] See Restatement (Second) of Torts §822 (Amer. Law Inst. 1965).
[302] Restatement (Second) of Torts, § 821B (Amer. Law Inst. 1979).

wood smoke emissions that create a significant public health hazard, even where the activity is not found to be in violation of other laws and regulations.[303]

State, local, and tribal laws and regulations establish the scope of private and public nuisances, and commonly include general standards for what constitutes a nuisance, as well as specific examples of nuisances. Court decisions also help define the scope of what constitutes a nuisance. The removal and abatement of public nuisances is a long-standing function of local governments, and even where public nuisances are established by state law, localities play a key role in enforcement.[304]

While this report does not discuss nuisance law in detail, following are examples of public nuisance provisions in current state and local laws that might apply to cases involving smoke impacts from indoor (or outdoor) wood-burning devices. It is important to consult state, local, or tribal policies to see whether there are any public nuisance provisions that might address wood smoke emissions in a particular community.

General Public Nuisance Standards. Public nuisance standards may be framed in general terms that are broad enough to encompass harm from neighboring wood smoke emissions in some situations. For example, *Connecticut* has a broad public nuisance standard; the health code directs local agencies to cause nuisances to be abated or remediated "which in their judgment may endanger the health of the inhabitants."[305] The state's environmental and health agencies have interpreted this provision to mean that, even though wood smoke is not specifically referenced, "a 'public health nuisance' includes a residential smoke condition caused by the use of an outdoor wood burning furnace, wood burning stove, fireplace, chiminea or other wood burning device, which uses the director has determined constitutes a nuisance that may endanger the health of the inhabitants."[306]

Nuisance provisions that address odor emissions might also be applicable to wood smoke emissions. The public nuisance code in the town of *Erie, Colorado* states: "It shall be unlawful and a public nuisance for any person...to permit the emission of odor from any source to result in detectable odors that leave the premises...to the exterior of the premises or any adjoining property or public right of way, and that causes annoyance of otherwise detrimentally affects the general health, safety, welfare or use and enjoyment of one's property."[307]

Some public nuisance provisions are crafted to apply only when a considerable number of people are affected.[308]

Air Pollutant/Smoke Emissions as a Public Nuisance. Some jurisdictions define a public nuisance to include specifically the emission of air pollutants or smoke that endanger health. For example:

[303] Id. ("Circumstances that may sustain a holding that an interference with a public right is unreasonable include...whether the conduct involves significant interference with the public health....").
[304] See, e.g., Ct. Gen. Stat. §19a-206(a).
[305] Id.
[306] State of Conn., Response to Wood Burning Complaints in Connecticut at 6 (2010). The guidance references a number of state decisions affirming the authority of local health officials to take action. Id. at 10 (noting, e.g., In the case of Sally Huyser v. Trumbull Monroe Health District, CT Department of Public Health, (2009) which held "Appellant is not entitled, as a matter of law, to maintain a nuisance; there are other forms of heat that appellant can install that would not create a nuisance or filth that adversely impacts on the health of her neighbors").
[307] Erie (CO) Mun. Code §5-1-6(H).
[308] See, e.g., Ca. Penal Code §370 (affecting "an entire community" or a "considerable number of persons"); Mont. Code Ann. §45-8-111(1) (entire community or neighborhood" or "any considerable number of persons").

- *Ft. Collins, Colorado* declares opacity violations to be a nuisance, and also establishes this public nuisance standard for smoke: "The emission or escape into the open air from any source or sources of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, odors or any other substances or combination of substances in such manner or in such amounts as to endanger or tend to endanger the health, comfort, safety or welfare of the public or to cause unreasonable injury or damage to property or to interfere with the comfortable enjoyment of property or normal conduct of business is hereby found and declared to be a public nuisance. It is unlawful for any person to cause, permit or maintain any such public nuisance within the City."[309]

- The city of *St. Louis, Missouri* has adopted a similar nuisance measure for smoke: "The emission or escape into the ambient...air within the City from any source or sources whatsoever of smoke, ashes, dust, soot, cinders, dirt, grime, acids, fumes, gases, vapors, odors, or any other substances...in such amounts as are detrimental to, or endanger the health, comfort, safety, welfare, property, or the normal conduct of business shall constitute a public nuisance, and it is considered unlawful for any person to cause, permit, or maintain any such public nuisance. The Commissioner of Health...may give additional consideration to the presence of emissions that cause severe annoyance or discomfort, or are offensive and objectionable to a significant number of citizens...."[310]

Public nuisance standards can be a tool for addressing local wood smoke impacts.

- The city of *Davis, California* lists conditions and activities that constitute a public nuisance, including specifically emissions from noncompliant wood burning devices: the "emission into the open air of visible smoke" from an indoor residential wood-burning device that is not an EPA-certified device or a pellet heater, "in such manner or in such amounts as to endanger or tend to endanger the health, comfort, safety or welfare of any reasonable person or to cause unreasonable injury or damage to property or which could cause annoyance or discomfort in the area of the emission."[311]

Enforcement: Regulatory Inspections and Complaint Response

A clear performance standard – whether through air pollution or nuisance authority – can be a mechanism for addressing wood smoke emissions that create significant air quality and health risks. These standards can be enforced through proactive regulatory compliance inspections, and through agency response to complaints from members of the public.

As noted earlier, some jurisdictions conduct periodic or regular inspections to verify compliance with burn restrictions during curtailment periods or to monitor compliance with general opacity standards. Agencies throughout the U.S. are also called upon to enforce opacity and nuisance standards in response to smoke complaints from residents. As a recent New York State report noted, "excessive smoke from inefficient devices often generates smoke nuisance complaints that pit neighbor against neighbor."[312]

---

[309] Ft. Collins (CO) Mun. Code §20-1.
[310] St. Louis (MO) Mun. Code §11.34.120.
[311] City of Davis (CA) Mun. Code §23.01.030(b)(14).
[312] NYSERDA, New York State Wood Heat Report: An Energy, Environmental, and Market Assessment at iii (2016), https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/15-26-NYS-Wood-Heat-Report.pdf. See also, U.S. EPA, Frequent Questions About Wood Burning Appliances: Smoke from my Neighbor is

Enforcement Mechanisms. Enforcement measures available to address wood-burning emissions may be established in general air quality and public health laws and regulations, or they may be incorporated into a law or regulation that addresses wood-burning devices specifically. Common enforcement tools include orders to correct violations and issuance of fines, as well as other civil and criminal penalties.[313]

It is not uncommon for jurisdictions to handle first violations as warnings that are accompanied by educational information, with penalties reserved for subsequent violations. This approach may be formalized in law or regulations, or it may be implemented as part of an agency's enforcement discretion.

For example, regulations in *Lincoln County, Montana* require that the first Notice of Violation be considered a warning to the violator and "include educational and compliance information on air pollution regulations." For any subsequent violation, a notice to appear and complaint citation must be served.[314] Rules in *Klamath County, Oregon* provide that "minor" violations result in Notice of Violation, while repeated or major violations result in the issuance of a citation and summons to appear in court.[315] When responding to the first complaint about a particular address, the *Puget Sound CAA* in Washington sends a letter with educational materials.[316] The *Bay Area AQMD* advises residents that first time violators will be issued a Notice of Violation and a $100 fine, but that violators "may have a one-time only opportunity to take the Air District's Wood Smoke Awareness Written Test in lieu of paying the fine." Subsequent violations are subject to an unavoidable $500 fine, with continued violations subject to increasing penalties.[317]

This staged approach to enforcement is often applied to violations of curtailment provisions as well. For example, in *Portola, California*, first time violators receive a Notice to Comply or Warning, requiring EPA-certified heaters to be registered. For second violations, violators may complete a wood smoke awareness course, pay a penalty of $50, or submit proof of replacement of any non-certified device with an EPA-certified wood heater or non-wood-burning device. Third and fourth violations required either a higher monetary penalty or proof of device replacement.[318] In *Salt Lake County, Utah*, curtailment regulations required the county to provide educational materials and information for about a year following adoption of the regulations, after which the county could begin enforcing the prohibitions on burning.[319]

Wood smoke complaints are typically handled at the local level, and some local jurisdictions make it easier for people to file a complaint by providing a tailored online complaint form. For example, the *Bay Area AQMD*

Impacting my Air Quality and Health, What Can I Do?, https://www.epa.gov/burnwise/frequent-questions-about-wood-burning-appliances#pollution.

[313] See, e.g., Ct. Gen. Stat. §19a-206; Ct. Admin. Code §19-13-B2 (nuisances); New York City Admin. Code, §§24-178(a), 24-180, 24-182 (air pollution); Mendocino County AQMD Regulation 4.1-500, -520 (wood-burning appliances).

[314] Lincoln County (MT) Air Pollution Regs. §75.1.207.

[315] Klamath County (OR) Ord. 63.06, §406.300.

[316] Puget Sound CAA, Residential Chimney Smoke Complaint Form, https://secure.pscleanair.org/Complaint/ChimneySmoke.aspx. Agency regulations provide that: "As an additional means of enforcement, the Board or Control Officer may accept an assurance of discontinuance of any act or practice deemed in violation" of state law. Puget Sound CAA Reg. I, §3.15(b).

[317] Bay Area AQMD, Frequently Asked Questions Reg. 6, Rule 3 (rev. Feb. 2020), https://www.baaqmd.gov/~/media/files/compliance-and-enforcement/wood-burning/2019-amendments/faq-pdf.pdf?la=en.

[318] City of Portola (CA) Mun. Code §15.10.060(C). See also Maricopa County (AZ) Air Pollution Control Regs., P-26 § 3(E) (warning for first violator, followed by increasing civil penalties/tickets for subsequent violations).

[319] Salt Lake County (UT) Health Regulation #35, § 8.1.

has a user-friendly and confidential online form that asks specific questions about when the problem occurred and the nature of the smoke.[320]

State agencies respond to wood smoke complaints as well. *Oregon's* environmental agency has a wood smoke web page that notes that the state will handle complaints involving a neighbor's wood stove by sending a letter that explains the health effects of wood smoke, asks the individual to reduce the smoke, and provides tips for doing so. The web page includes a link to the agency's general air pollution complaint portal.[321] The *Alaska* DEC responds to wood stove complaints, and the agency's web pages describing opacity and visible emissions rules provide a link to the state's general air quality complaint form.[322] *Colorado* maintains a 24-hour indoor burning hotline from November 1 through March 31, when burning restrictions apply in the Denver metropolitan area; the state checks the hotline regularly and follows up with callers in localities that lack their own air ordinance.[323]

Enforcement Challenges. As with many environmental and public health issues, there are considerable practical challenges to enforcing opacity limits and nuisance standards – notably, the technical and logistical requirements for investigating a potential violation and the financial resources needed to pursue a case. These enforcement decisions are set against a backdrop of public perceptions that may include a lack of awareness about proper wood-burning techniques or about the health effects of wood smoke, as well as strong opposition by some community members to any restrictions on wood burning.

Technical Requirements for Observing Smoke Violations. Opacity limits can be difficult to implement due to the practical challenges in measuring the opacity of smoke leaving a residential chimney. EPA Method 9 requires trained, certified observers and acceptable observation conditions. A Method 9 test cannot be conducted in the dark, yet burning often occurs in winter in the late afternoon and evenings, when there is limited or no daylight.[324] Trees or other obstructions also may make it difficult to confirm the source of the smoke. And wood smoke problems often occur after regular business hours, when inspectors and other staff are not available.

Where performance standards are framed instead in terms of limiting visible emissions, EPA Method 22 could provide a more streamlined approach to collecting photographic or video evidence of potential violations. Determinations of compliance with a prohibition on visible smoke (i.e., any opacity) may also be less subjective than opacity measurements. In *Albuquerque/Bernalillo County, New Mexico*, rules prohibit visible emissions during curtailment periods and state:

---

[320] Bay Area AQMD, Wood Smoke Complaint, https://permits.baaqmd.gov/aq/#/woodsmoke/complaint. See also, Puget Sound CAA, Residential Chimney Smoke Complaint Form, https://secure.pscleanair.org/Complaint/ChimneySmoke.aspx; Washington County (OR), Complaint Form, https://www.co.washington.or.us/HHS/EnvironmentalHealth/AirQuality/wood-burning-complaint-form.cfm#top.

[321] Oregon Dept. of Envtl. Quality, Health Effects of Wood Smoke, https://www.oregon.gov/deq/Residential/Pages/Woodstoves-Health.aspx. A 2006 NESCAUM report detailed several enforcement actions taken by northeastern states in response to complaints about outdoor wood boilers. NESCAUM, Assessment of Wood-Fired Boilers at 6-6, https://dec.vermont.gov/sites/dec/files/aqc/compliance/documents/S17%20OWB-Report3-06.pdf.

[322] Ak. Dept. of Envtl. Cons., Solid Fuel-Fired Heating Device Visible Emission And Opacity Limits, https://dec.alaska.gov/air/burnwise/opacity/.

[323] Col. Dept. of Public Health & Envt., Indoor Burning Frequently Requested Information, https://cdphe.colorado.gov/indoor-burning-frequently-requested-information.

[324] E. Semmons, et al., Indoor particulate Matter in Rural, Wood Stove Heated Homes, Environ Res. 138: 93–100 (Apr. 2015), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4385435/#__ffn_sectitle (study of wood burning households observing that indoor $PM_{2.5}$ peaked between 6 pm and 10 pm).

> *"To determine compliance with this standard, the Director shall observe the point at which the certified wood heater releases emissions into the ambient air. If the emission point is producing any visible emissions twenty (20) minutes or longer after the initial observation, a violation of this Part has occurred*."[325]

Curtailment rules in both *Oregon* and *Washington*, which prohibit burning during the most stringent curtailment periods, establish that visible smoke emitted from a chimney creates a rebuttable presumption of a violation.[326] Washington's *Puget Sound CAA* enforces burn bans by conducting patrols during daytime and nighttime hours, looking for smoke that exceeds 20 percent opacity and also checking for visible smoke. Agency officials "look for visible smoke, as an indication of possible illegal burning, and will collect photo documentation."[327]

Resources Needed for Field Enforcement. Enforcement can require substantial financial resources for initial and ongoing staff training and for sending inspectors into the field during or after traditional daytime office hours. Policies that allow opacity exceedances for device startup or refueling may mean spending more time at a particular location.

Absent targeted resources, enforcement competes with other activities for reducing wood smoke emissions, such as education and financial incentives. Funding for local agencies is especially important in order to enable local agencies to carry out or assist with compliance assistance and enforcement. *Washington* law establishes a *wood stove education and enforcement account*, to be used solely for the purposes of public education and enforcement of the solid fuel burning device program. The account is supported by a fee on retail purchases of new or used devices, with two-thirds of the funds distributed to local air pollution authorities.[328]

Targeted education and outreach may help reduce the need for enforcement. Agencies could, e.g., provide easy-to-understand information about current wood burning regulations – including nuisance and other applicable standards – as well as tips on how to work with neighbors to resolve smoke nuisances. The *Puget Sound CAA* provides images of different smoke opacity levels and notes that it "is always illegal to smoke out your neighbor. Everyone has a right to breathe clean air. If smoke from your fire is affecting your neighbors, it is considered a nuisance and subject to enforcement action."[329] The *Tulalip Tribe* provides a web page on reducing emissions from wood-burning devices and advises: "Don't burn when air currents carry your smoke to your neighbor's yard or house."[330] The *Oregon* Department of Environmental Quality advises residents

[325] N.M. Admin. Code §20.11.22.15(A).
[326] Wash. Admin. Code §173-433-150(5),(6) (visible smoke emitted after 3 hours has elapsed from the declaration of the curtailment period); Or. Admin. Code §340-262-0800 (applicable where included as a contingency plan for PM nonattainment or maintenance areas as part of Oregon's SIP).
[327] Puget Sound CAA et al., Burn Ban Enforcement Has Begun, http://www.airsafepiercecounty.org/burn-bans (accessed 1/8/21). Staff from local partner agencies assist with enforcement, but all violations are issued by the Puget Sound Clean Air Agency.
[328] Rev. Code Wash. § 70A.15.3620; Wash. Admin. Code §173-455-060.
[329] Puget Sound CAA, Wood Burning and the Law, https://www.pscleanair.gov/170/Legal-Overview. See also, e.g., Lane Regional Air Protection Agency (OR), Wood Home Heating Advisory http://www.lrapa.org/181/Home-Wood-Heating-Program.
[330] Tulalip Air Quality Program, Wood Smoke and Your Health, https://www.tulaliptribes-nsn.gov/air_quality/wood_smoke.htm.

affected by wood smoke to: "Talk to your neighbor first. State the problem, offer information about the impacts of wood smoke and ask for their cooperation."[331]

Chapter 4 discusses more broadly how policies can support programs to provide information and technical assistance for reducing wood-burning emissions.

Policy Strategy: Establish Operating Requirements

In addition to whether and when a wood-burning device may be used, *how* the device is used is a key factor in reducing wood smoke emissions. Important elements include starting and refueling techniques, air-to-fuel ratio, and temperature of the fire. Perhaps most important – and the subject of many policies and programs – are the characteristics of the fuel that is used. As the New York State Energy Research and Development Authority has noted, even "low-emitting, high-efficiency devices will not work properly, if used with improper fuels."[332] Firewood should be properly seasoned, split, stacked, and stored. EPA recommends seasoning wood for six months and advises that "wood burns best at a moisture content of less than 20 percent."[333]

Requirements for operating practices that occur inside a home are challenging to enforce, but they can help support agencies' routine monitoring and response to complaints. This section provides an overview of policies that:

- Require proper operating practices; and
- Restrict what materials may be burned in devices.

In addition to regulatory requirements, policies to provide information, technical assistance, and financial assistance on proper burning practices are also vitally important and are described in the final two chapters of the report.

General Operating Practices

Requirements for proper operation of wood-burning devices have been established within two different spheres of regulatory authority: air quality and property maintenance.

Air Quality Policies. EPA's wood heater rule includes a general requirement that addresses proper operating practices for new devices covered by the rule:

[331] Or. Dept. of Envtl. Quality, Health Effects of Wood Smoke, https://www.oregon.gov/deq/Residential/Pages/Woodstoves-Health.aspx.
[332] NYSERDA, New York State Wood Heat Report: An Energy, Environmental, and Market Assessment at 61 (2016), https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/15-26-NYS-Wood-Heat-Report.pdf.
[333] U.S. EPA, Best Wood-Burning Practices, https://www.epa.gov/burnwise/best-wood-burning-practices. See also, Placer County APCD, Wood Burning Handbook, https://www.placer.ca.gov/DocumentCenter/View/1481/Wood-Burning-Handbook-PDF ("Firewood should dry, or "season" a minimum of 6 to 12 months after splitting. Hardwoods dry more slowly than softwoods and may take over a year to dry.").

"*No person is permitted to install or operate an affected wood heater except in a manner consistent with the instructions on its permanent label and in the owner's manual...including only using fuels for which the unit is certified*."[334]

The rule requires that wood heaters sold commercially must be accompanied by an owner's manual that provides information for proper operation and maintenance, including "minimizing visible emissions" – e.g., fire starting procedures, proper use of air controls, fuel loading and re-loading procedures, recommendations on fuel selection, and warnings on what fuels not to use. An Appendix to the rule provides "specific instructions and examples to manufacturers for compliance with the owner's manual provisions" of the rule. The information in the manual must be consistent with instructions used in laboratory emissions testing of the device and "adequate to enable consumers to achieve optimal emissions performance."[335]

Although the EPA rule establishes a basis for taking enforcement or compliance assistance actions to address improper burning practices for devices covered by the rule, the agency does not appear to have used this authority to date. As noted earlier, the 2015 rule amendments established that EPA may delegate enforcement authority to states, localities, and tribes.

Many jurisdictions have laws or regulations that establish the same basic requirement included in the federal rule: to operate devices in accordance with the manufacturer's instructions. For example, in *Albuquerque/Bernalillo County***,** *New Mexico*, it is a violation of air rules if a person fails "to comply with all manufacturers' installation and operations instructions" for solid fuel heating devices.[336] *Vermont* rules prohibit operating a device unless it complies with installation requirements, manufacturer's instructions, and other applicable laws.[337]

Some jurisdictions include more expansive provisions governing operating practices. For example:

- The *Placer County APCD* in California requires all wood-burning appliances to be installed and operated according to the manufacturer's specifications. The district's rule requires further: "No wood burning appliance shall be altered, installed, or disassembled in any way not specified by the manufacturer, or *operated in any manner that could result in an additional emissions exceedance*."[338]

- In *Missoula, Montana*, outside the Air Stagnation Zone, "solid fuel burning devices approved for installation must be installed, maintained and operated *in the same fashion under which they were tested*."[339]

- Anyone who seeks a sole-source exemption from mandatory burn bans in the *Bay Area AQMD* must register the device and maintain documentation that the device is operated according to the manufacturer's specifications.[340]

Although most policies do not specify requirements for device inspections*,* some jurisdictions require inspections in certain situations. As noted earlier, the *San Joaquin Valley APCD* and *Klamath County, Oregon*

[334] 40 CFR 60.538(e). The rule sets forth the information that must be provided in the owner's manual. 40 CFR 60.536(g).
[335] 40 CFR 60.536(g); 40 CFR Pt. Appendix I to Part 60, §2.3.9.
[336] N.M. Admin. Code §20.11.22.16.
[337] Vt. Admin. Code 12-031-001 §5-204(c)(3).
[338] Placer County APCD Rule 225, §304.1 (emphasis added).
[339] Missoula (MT) City-County Air Pollution Rules § 9.204(4) (emphasis added). Approved devices may not be installed with flue damper unless they were so equipped when tested. Id. §9.204(3).
[340] Bay Area AQMD Reg. 6, Rule 3 §404.

are examples of jurisdictions that require inspections in connection with granting exemptions for burning during mandatory curtailment periods.[341] Under EPA's wood heater rule, the required owner's manual for wood heaters must include specific statements about the need for periodic inspections.[342]

Property Maintenance Codes. Requirements for device maintenance and inspections might also be incorporated into property maintenance (housing) codes adopted by states, localities, or tribes. Many, but not all, local jurisdictions in the U.S. are covered by a state or local housing code. These codes are most often adopted at the local level, but more than a dozen states have adopted a statewide minimum housing code. While some housing codes set standards for all housing, they are more commonly implemented to ensure minimum standards for rental properties, which are home to a larger percentage of lower-income families than owner-occupied dwellings.[343]

Some jurisdictions have adopted a housing code based on the International Property Maintenance Code (or IPMC, a model code developed by the International Code Council), while others have developed their own codes.[344] The IPMC (Section 603.1) requires that: "Mechanical equipment, appliances, fireplaces, solid fuel burning appliances, cooking appliances and water heating appliances shall be properly installed and maintained in a safe working condition, and shall be capable of performing the intended function." Thus, a common provision of state and local housing codes is a general requirement that property owners maintain any installed wood-burning devices, which can help protect tenants and neighbors. This requirement may be enforced through the housing code inspection process. Local officials usually have authority to conduct inspections, issue citations, and pursue administrative, civil, and criminal enforcement actions in the event of noncompliance with housing codes.

Fuel/Material Burned in Devices

Allowed and Prohibited Materials. EPA's wood heater rule includes a list of items that may not be burned in regulated wood heaters, including garbage; yard waste; construction debris; paper products; waste petroleum products; and materials containing rubber, plastic, or asbestos. Notably, the list also includes unseasoned wood (defined as wood with an average moisture content of 20 percent or more) and "any materials that were not included in the certification tests for the subject wood heater."[345] Chip wood and pellets may only be burned as specified in the owner's manual, and the rule includes chip wood fuel standards for moisture content, inorganic fines, chlorides, ash content, and trace metals.[346]

In 2020, following review of public comments, EPA revised the fuel requirements for pellet stoves that had been adopted in the 2015 rule. The 2020 rule amendment removed the minimum requirements for pellets that could be burned in a certified pellet stove, which had included standards for density, dimensions,

[341] San Joaquin Unified APCD Rule 4901, §§5.9.2.1.3, 5.10.2.1; Klamath County (OR) Public Health, Request for Exemption 2018-2019, http://www.klamathcounty.org/DocumentCenter/View/21803/Exemption-Application-2018-2019-revised-with-deadlinepdf (no inspection required if device permitted within the preceding four years).
[342] 40 CFR 60.536(g); 40 CFR Appendix I to Part 60, § 2.3.9, 2.3.6. Some jurisdictions outside the U.S. have requirements for the regular inspection of heating appliances. See Intl. Institute for Applied Systems Analysis, Measures to Address Air Pollution from Small Combustion Sources (2018) at 27, https://ec.europa.eu/environment/air/pdf/clean_air_outlook_combustion_sources_report.pdf.
[343] For example, according to 2019 census data, 50% of renter households had incomes under 40,000, compared to 30% of owner-occupied households U.S. Census Bureau, American Housing Survey (2019), https://bit.ly/39YbAqx.
[344] ICC, International Property Maintenance Code (2018), https://codes.iccsafe.org/content/IPMC2018.
[345] 40 CFR 60.532(f)(14). The list also includes, e.g., garbage; yard waste; construction debris; paper products; waste petroleum products; and materials containing rubber, plastic, or asbestos.
[346] 40 CFR 60.532(d), 60.531.

inorganic fines, chlorides, ash, and trace metals. In removing the pellet fuel standards, the agency explained that a private pellet-grading system exists, in that "minimum requirements/specifications are already part of [the Pellet Fuel Institute's] and other third-parties' requirements" for grading pellets.[347]

The rule now in effect requires that pellet fuel must not contain any of the prohibited fuels listed in the regulation. It states further that device operators may only burn pellets that are "graded under a licensing agreement with a third-party organization approved by the EPA," including a certification that the pellets do not contain any of the fuels prohibited generally by the rule. According to the rule, the Pellet Fuels Institute, ENplus, and CANplus are initially deemed to be approved third-party organizations, and additional organizations may apply for approval.[348]

Most states with laws and regulations aimed at reducing air pollution from wood-burning devices include provisions governing what material may be burned. In many cases, these policies are framed as a list of items that may *not* be burned. The list typically includes items similar to those in the federal rule (e.g., trash, chemicals, plastic, construction debris, metals). Some policies are more expansive, setting forth an exclusive list of items that *may* be burned. For example, in *Missoula County, Montana*, a person may not burn any material in a solid fuel burning device except uncolored newspaper, untreated wood and lumber, and

A number of policies include a requirement for "seasoned" wood, commonly defined as having a moisture content of 20 percent or less.

For example, the *Placer County APCD* prohibits non-seasoned or green wood with more than 20 percent moisture content, as well as "any other material not intended by a manufacturer for use as fuel in a solid fuel burning device."[349] The *Bay Area AQMD* also includes "non-seasoned wood" in its list of prohibited materials and defines seasoned wood as having moisture content of 20 percent or less.[350] In *Alaska's* nonattainment areas, from October through March, dry wood is the only fuel allowed.[351] *Washington* state rules list a number of commonly prohibited items and add: "Any substance which normally emits dense smoke or obnoxious odors other than paper to start the fire, properly seasoned fuel wood, or coal with sulfur content less than 1.0% by weight burned in a coal-only heater."[352] *Klamath County, Oregon* requires those receiving an exemption from mandatory curtailment periods to agree that they will verify, using a moisture meter, that their wood has less than 15 percent moisture.[353]

---

[347] 85 Fed. Reg. 18448 at IV(A)(2). A 2012 study analyzing U.S. and Canadian pellet samples found that "although heavy elements are found naturally in wood and bark, some pellet samples had unusually high concentrations of heavy elements" including arsenic, copper, and chromium and concluded that "standards for elemental compositions of commercial wood pellets and chips need to be established in the United States to exclude extraneous materials." S. Chandrasekaran et al., Chemical Composition of Wood Chips and Wood Pellets, *Energy & Fuels* 26(8):4932-4937 (2012), https://www.researchgate.net/publication/233834706_Chemical_Composition_of_Wood_Chips_and_Wood_Pellets.

[348] 40 CFR 60.532(e). For a review of wood pellet/chip specifications in the U.S. and Europe, see NYSERDA, New York State Wood Heat Report: An Energy, Environmental, and Market Assessment at 53-60 (2016), https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/15-26-NYS-Wood-Heat-Report.pdf.

[349] Placer County APCD Rule 225, § 305. Moisture content is to be measured by ASTM method D4442-92. Id. §501.2

[350] Bay Area AQMD Reg. 6, Rule 3 §6-3-309.

[351] 18 Ak. Admin. Code §50.076(b). State rules also include a list of items that may not be used in a device. 18 AAC §50.076(c).

[352] Wash. Admin. Code. §§173-433-120 (emphasis added); Rev. Code Wash. §70.15.3600(1).

[353] Klamath County Public Health Wood Stove Exemption Applicant Information (2020), https://www.klamathcounty.org/DocumentCenter/View/26892/woodstove-exemption-application.

None of the policies reviewed for this report establish their own standards for pellets used in pellet heaters. However, New York has addressed the issue of *off-gassing of carbon monoxide* from wood pellet storage. According to the state Department of Health, a "chemical reaction that produces carbon monoxide (CO) gas can occur when wood pellets are stored." To minimize the risks of CO poisoning, the agency recommends that wood pellets be "safely stored in a separate structure outside" the home.[354] The New York State Energy Research and Development Authority also recommends storing bulk pellets "in dry outdoor locations such as in silos or sheds" and requires outside storage of bulk pellets for pellet stoves funded by the agency.[355]

Regulation of Wood Sales. In addition to regulating the moisture content of wood, some policies place requirements on sellers of wood to help ensure that consumers know whether their firewood is dry. The *Bay Area AQMD*, for example, gives those who supply or sell firewood two options: (1) sell firewood with a moisture content of 20 percent or less, or (2) identify the firewood as unseasoned and include instructions on how to dry out the wood to a 20 percent moisture content before burning. In either case, the wood must be labeled as specified in the rules.[356] The rules also establish how moisture content is to be measured.[357] *Washoe County, Nevada* establishes that wood with a moisture content over 20 percent must include a disclosure stating the excessive moisture content and recommending a seasoning period to obtain a moisture content of 20 percent or less.[358]

Alaska is unusual in establishing a wood seller registration program as a framework for both disclosing information to customers and ensuring compliance with state requirements for wood moisture content. The program, designed for commercial wood sellers,[359] began as a voluntary statewide initiative; as of August 2017, it became mandatory in the serious nonattainment area. Registered wood sellers must obtain a state-issued business license and a state-approved moisture meter. Registration is renewed every three years, and no fee is required. The state maintains and makes available to the public a list of registered wood sellers.[360]

Under Alaska's program, commercial wood sellers who are required to register must test the moisture content of a load of wood at the time of sale or delivery to the consumer, in accordance with the testing guidelines included in the rules, and must give the consumer a signed moisture content disclosure form. Wood sellers who fail to comply with these requirements are subject to training; temporary removal from the list of registered wood sellers; revocation of registration; notice of violation; or enforcement action as provided under state law.[361] Beginning October 1, 2021, new restrictions on the sale of wet wood apply in the serious nonattainment area, and the sale of dry wood requires additional documentation and recordkeeping.[362]

---

[354] N.Y. State Dept. of Health, Carbon Monoxide (CO) Hazards from Wood Pellet Storage, https://www.health.ny.gov/environmental/emergency/weather/carbon_monoxide/docs/pellets.pdf.
[355] NYSERDA, Residential Pellet Stoves: FAQ, https://www.nyserda.ny.gov/All-Programs/Programs/Renewable-Heat-NY/Residential-Wood-Pellet-Stove/Residential-Pellet-Stove-Program-FAQ.
[356] Bay Area AQMD Reg. 6, Rule 3 §§310, 403.3.
[357] Id. §6-3-602 ("Moisture content of wood shall be determined by ASTM Test Method D 4442-92 or a hand-held moisture meter operated in accordance with ASTM Test Method D 4444-92, Standard Test Methods for Use and Calibration of Hand Held Moisture Meters.").
[358] Washoe County (NV) Health District Regs. §040.051(C)(5).
[359] The program does not apply to those who sell only: wood pellets, bricks, or pucks; compressed wood logs; or small bundles of split, dry wood. 18 Ak. Admin. Code §50.076(h).
[360] 18 Ak. Admin. Code §§50.076(d),(e),(f)(3). See generally, Alaska DEC, Wood Seller Information, https://dec.alaska.gov/air/burnwise/wood-seller/.
[361] 18 Ak. Admin. Code §50.076(g).
[362] 18 Ak. Admin. Code §50.076(j),(k). See also Alaska DEC, 2021 Wood Moisture Information, https://dec.alaska.gov/air/burnwise/2021-wood-moisture-information/.

CHAPTER 4
Information and Education

Public education is essential to reducing exposure to wood smoke. EPA's Burn Wise program and many states, localities, and tribes have robust education programs and web pages. These initiatives communicate and demonstrate the wood-burning techniques that are necessary for reducing emissions from wood-burning devices. They also inform community residents about the potential cardiovascular, respiratory, and other serious health impacts – on their own households and on neighbors – from breathing wood smoke pollutants.

Education programs are important on their own and in conjunction with programs designed to help pay for wood stove replacement. One study of a wood stove replacement program found that not only is targeted education and outreach "a critical component of the overall success" of such programs, but that "effective messaging to homeowners on proper use of their new stove is a necessary task" of the programs.[363]

Policy can play an important role in advancing public education in a number of ways. Washington state and Marin County, California are examples of jurisdictions that have enacted laws requiring and/or funding agency education programs on wood smoke and wood-burning devices.[364] Policies can also leverage key commercial transactions to help ensure that information about wood burning devices, practices, and regulations is provided to consumers.

This chapter describes policies that require information to be provided to purchasers and owners of devices during:

- Residential real property transfers;
- Device sales and installations; and
- Wood sales.

[363] See T. Ward, et al., Lessons Learned from a Woodstove Changeout on the Nez Perce Reservation*, Sci. Total Environ*., 409(4):664-70 (2011).

[364] See, e.g., Rev. Code Wash. §70a.15.3620; Wa. Admin. Code §173-455-060 (establishing a fee on purchase of solid fuel burning devices to be used solely for enforcement and for public education and about the health and environmental effects of solid fuel burning device emissions and methods of reducing emissions); Marin County (CA) Mun. Code §19.08.050 ("the county through the chief building official shall establish and maintain an ongoing program to educate the public on the provisions of this chapter and the health impact of wood smoke" and "encourage cleaner-burning alternatives such as gas-fueled devices, pellet stoves and proper wood-burning techniques").

Policy Strategy: Require Information During Key Commercial Transactions

Information During Residential Property Transfers

The sale or leasing of a home is an important opportunity for providing information about wood-burning devices. As noted earlier, it is not uncommon for mandatory property disclosure forms for home sales to include information about whether there are solid fuel burning devices in the home. It is unlikely, though, that information about whether devices are present on the property will on its own educate buyers or prompt action.

Other types of information could be required when a property is sold or leased, including:

- The health effects of wood smoke;
- The importance of proper burning techniques;
- Any legal restrictions on wood burning that apply within the jurisdiction, including requirements for removing devices, installation restrictions, and burn bans; and
- Resources that can assist in reducing emissions and exposure.

This information could be included as part of an existing mandatory disclosure form and/or as separate document or pamphlet. The agency responsible for implementing the regulations could be charged with developing and updating the required notification language, including a website for getting additional information.

The sale of a home is an opportunity to notify buyers about the health effects of wood smoke.

The *Bay Area AQMD* is an example of a jurisdiction that requires a notification about wood burning for both the sale and leasing of a property. The district's wood-burning rule requires that:

> "*Effective June 1, 2016, any person selling, renting or leasing real property shall provide sale or rental disclosure documents that describe the health hazards of $PM_{2.5}$ from burning wood or any solid fuel as a source of heat. Disclosure documents must disclose $PM_{2.5}$ health hazards in accordance with guidance made available on the District's website*."[365]

The half-page disclosure statement developed by the district includes information about health effects, proper maintenance and operations, and regulatory restrictions on wood burning within the district. The disclosure must be signed and dated by the buyer or renter upon receipt.[366]

Some states have achieved significant results from using notification during the real estate transaction to address a different indoor pollutant with serious health impacts – radon gas. Illinois and Minnesota have enacted radon notification laws requiring that sellers provide buyers with (1) a state-developed pamphlet about radon and (2) a warning statement that describes the health effects of radon and includes a

[365] Bay Area AQMD Reg. 6, Rule 3 §304.
[366] Bay Area AQMD, Compliance Advisory: Regulation 6, Rule 3: Wood-Burning Devices (March 15, 2016), https://www.baaqmd.gov/~/media/files/communications-and-outreach/wood-smoke/residential-fireplace-disclosure-031516-pdf.pdf?la=en.

recommendation from the state to test for and mitigate high radon levels on the property.[367] Both states saw increases in radon testing and mitigation following passage of the legislation.[368]

Information During Device Sales and Installations

New sales and installations of wood-burning devices are important occasions for providing information about best burning practices. New wood stoves may require training, even for people who have owned stoves in the past, as newer models operate differently and have more sophisticated technical features. Policies could require sellers and installers to provide information and training to help ensure that owners understand how to operate their new devices to reduce emissions.

As noted earlier, EPA's wood heater rule requires that heaters sold commercially must be accompanied by an owner's manual that provides information about proper operation and maintenance, including "minimizing visible emissions."[369] EPA has authority to enforce the requirement or to delegate enforcement authority, and many jurisdictions have incorporated the federal rule into their own laws and regulations.

A number of jurisdictions have laws or regulations requiring that additional materials be provided when a device is sold or installed, in order to highlight the health effects of wood smoke and/or best practices for reducing emissions. The *Bay Area AQMD* has established a requirement that applies to both new *and* used wood-burning devices: Sellers and installers must provide public awareness information to each purchaser "in the form of pamphlets, brochures, or fact sheets addressing proper installation, operation, and maintenance of the wood-burning device and the health effects of wood smoke." This information must include the following direct statement set forth in the rules: "Wood smoke contains harmful particulate matter (PM) which is associated with numerous negative health effects."[370]

A number of other jurisdictions include requirements that apply to the sale of new wood heaters. For example, the *San Joaquin Unified APCD* requires retailers to provide buyers information about: proper installation, operation, and maintenance of the heater; proper fuel selection and use; health effects from wood smoke; home weatherization methods; proper sizing of wood burning heaters; and Episodic Wood Burning Curtailment levels.[371] Other jurisdictions in California, including the *Placer County APCD* and the city of *Portola*, include a similar requirement.[372] Vendors of wood-fired heating devices in *Alaska* must provide the buyer information about curtailment requirements and proper operating methods.[373]

Product Labeling

Wood Stove Labeling. EPA's wood heater rule includes a labeling requirement for devices covered by the rule. The label must include information about emissions ("certification test emission value, test method and standard met") as well as the following statement:

[367] 420 Il. Comp. Stat. §46/10; Mn. Stat. §144.496.
[368] See AARST/NRPP, Policies to Prevent Radon Exposure, the #1 Leading Cause of Death in Homes (2017), http://aarst-nrpp.com/wp/wp-content/uploads/2017/08/Policies-to-Prevent-2017.pdf.
[369] 40 CFR 60.536(g)(3).
[370] Bay Area AQMD Reg. 6, Rule 3 §401.
[371] San Joaquin Valley APCD Rule 4901, §5.1.3.
[372] Placer County APCD Rule 225, §302.2.1 (applies to sellers/installers of new wood-burning devices in the Squaw Valley area); City of Portola (CA) Mun. Code §15.10.090 (applies to retailers/contractors selling new devices).
[373] 18 Ak. Admin. Code §50.077(k)(2).

"*This wood heater needs periodic inspection and repair for proper operation. Consult the owner's manual for further information. It is against federal regulations to operate this wood heater in a manner inconsistent with the operating instructions in the owner's manual*."[374]

State, local, and tribal governments could require labels containing additional information for new devices sold within their jurisdictions. *Missoula's* air rules, e.g., provide that new solid fuel burning devices sold in Missoula County must have a "clearly visible and legible label" that states where the solid fuel burning device can legally be installed in Missoula County and includes an informational contact phone number for the health department. The label must use language approved by the department and lettering must be in bold, 20-point type on a contrasting background.[375] Missoula's labeling requirement has proven useful in educating customers and directing them to the Health Department for more information. Online shopping may present greater challenges in this regard than in-person purchases.[376]

Firewood Labeling. In the *Bay Area AQMD*, any wood sold or provided for intended use in a wood-burning device within the district must be labeled. The label for seasoned firewood must state: "This wood meets air quality regulations for moisture content to be less than 20% (percent) by weight for cleaner burning." Unseasoned wood must bear a different label – "This wood does NOT meet air quality regulations for moisture content and must be properly dried before burning" – and must provide written instructions on how to properly dry the wood to achieve a 20 percent moisture content. The labels for both seasoned and unseasoned wood must also state: "Use of this and other solid fuels may be restricted at times by law. Please check 1- 877-4-NO-BURN or http://www.8774noburn.org/ before burning."[377]

As noted earlier, *Alaska's* wood seller registration program, which is mandatory in the nonattainment areas and voluntary elsewhere in the state, requires that wood sellers in the nonattainment area provide a moisture content disclosure form to customers. The form includes information such as the moisture content of the wood and the date it was cut.[378]

[374] 40 CFR 60.536(d).
[375] Missoula (MT) City-County Air Pollution Rules §9.402(1).
[376] ELI Communications with Missoula (MT) Health Department Officials (Feb. 2021).
[377] BAAQMD Reg. 6, Rule 3 §§403, 310.
[378] State of Alaska, Moisture Disclosure – Wood Seller Registration Program, available at: https://dec.alaska.gov/air/burnwise/wood-seller/.

CHAPTER 5
Financial Assistance for Reducing Wood Smoke Emissions

Financial assistance programs are vital to reducing emissions from wood-burning devices. Given limited resources, financial assistance for lowering wood smoke emissions should prioritize households that use wood heaters as a primary source for heat and those that lack financial resources to make needed changes. This assistance is important on its own and as a complement to regulatory policies that restrict the use of wood-burning devices.

In recent years, several jurisdictions, from Fairbanks, Alaska to the state of New York, have prioritized their financial incentives to replace wood stoves with lower-emitting devices, such as pellet stoves or non-wood heating appliances. This is an important consideration for other jurisdictions as well, given uncertainties over whether switching to new, certified wood heaters will produce the expected emissions reductions.

This chapter describes examples of public financial assistance programs that:

- Address wood-burning devices specifically; or
- Fund a broader set of activities, but could be tapped to support wood heater replacement and related emissions reduction activities.

Although the report discusses only government agency programs, other sources such as utilities, device manufacturers, public health organizations, and philanthropic foundations are also important avenues for funding.

In weighing state policy options, Oregon's 2016 legislative report emphasized coordination among funding sources and concluded that given the large number of uncertified wood stoves, "sustained funding is the only way to ensure communities have a consistent source of funding they can rely upon to address the problem and to maintain progress."[379] Ideally, all available programs within a jurisdiction would be coordinated to make best use of funds for reducing emissions and lowering heating costs to families.

[379] Or. Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 5 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf.

POLICY STRATEGY: DEVELOP A FUNDING PROGRAM FOR REDUCING WOOD SMOKE EMISSIONS

Many states, localities, and tribes have used a variety of funding sources to develop their own programs focused specifically on reducing emissions from wood-burning devices. Some jurisdictions have adopted laws or regulations expressly requiring agencies to develop such financial assistance programs.[380] These initiatives often fund the replacement of older devices, but they also provide materials and other in-kind resources to help families implement wood-burning practices that will reduce smoke.

Wood Stove Replacement. Wood stove replacement or "changeout" programs "target the replacement of older technology with cleaner, more efficient units by providing upfront financial assistance for the purchase of a new unit when an old unit is surrendered or otherwise disposed of in a documented, specified manner."[381] Some programs also provide incentive funding to recycle (but not necessarily replace) old wood stoves. Numerous states, localities, and tribes throughout the country have implemented wood stove changeout programs. Because much has been written about the elements of these programs and about the lessons learned from past experiences, they are not discussed in depth here.[382]

One central component of a changeout program is deciding which types of replacement heating devices are eligible for funding. This decision will depend in part on the terms of the grant or other funding the jurisdiction is using for the program.

Changeout programs commonly fund new, certified wood heaters and pellet heaters, though EPA recommends considering both wood *and* non-wood alternatives. Noting that "[p]romoting the cleanest appliance will provide greater reductions in particle pollution and other pollutants," EPA suggests that programs consider not only EPA-certified pellet and wood stoves, but other devices including natural gas stoves, propane stoves, and Energy Star® heat pumps and electric or gas furnaces.[383]

---

[380] See, e.g., Wa. Admin. Code §173-433-155(7) (requiring state or local air authority to "provide assistance to households using solid fuel burning devices to reduce the emissions from those devices or change out to a lower emission device" from June 2012 to December 2014); Co. Rev. Stat. §25-7-413 (requiring Denver area air planning agency to "work with other organizations to establish a program of financial incentives to encourage and defray the costs associated with conversions to Phase III wood stoves or to gas or electric devices" that includes incentives for energy-efficient devices); Yurok Tribal Code (Air Quality) §21.05.060 (directing the tribe's environmental agency to "seek to secure grant funds, including low-interest loans, from outside sources to assist persons who must comply with" the law's restrictions on installing wood-burning devices, where compliance would create financial hardship).

[381] NYSERDA, New York State Wood Heat Report: An Energy, Environmental, and Market Assessment at 82 (2016), https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/15-26-NYS-Wood-Heat-Report.pdf.

[382] See, e.g., U.S. EPA, How to Implement a Wood Burning Appliance Changeout Program (2014), https://www.epa.gov/sites/production/files/2015-08/documents/howtoimplementawoodstovechangeout.pdf; U.S. EPA, Case Studies of Wood Stove Changeout Campaigns, https://www.epa.gov/burnwise/case-studies-wood-stove-changeout-campaigns; Hearth, Patio and Barbeque Assoc., Wood Stove Changeout, https://www.hpba.org/Promotional-Campaigns/Woodstove-Changeouts/Ongoing-Changeout-Programs.

[383] EPA, How to Implement a Wood Burning Appliance Changeout Program at 4 (2014), https://www.epa.gov/sites/production/files/2015-08/documents/howtoimplementawoodstovechangeout.pdf. As noted earlier, recent studies have raised questions about whether $PM_{2.5}$ will be reduced *within* the home after a more efficient wood stove was installed. See supra note 58.

In light of the significant financial investment of public funds required, some jurisdictions have opted to prioritize funding of *non-wood alternatives*, given the lower particulate matter emissions that can be achieved. For example:

- A recent *Puget Sound CAA* changeout program in the Tacoma-Pierce County (Washington) Smoke Reduction Zone allowed only non-wood replacement options that met certain efficiency/emissions requirements, including electric heat pumps; natural gas, propane or oil furnaces; or natural gas, propane, or pellet stoves or inserts. Since incentives did not fully cover the cost of replacement, the program provided an exception for lower-income households – in most cases, they could receive a certified wood stove replacement with all of the costs covered by the program.[384] The changeout program in Snohomish County also has restrictions on eligible changeout devices and does not allow wood stove replacements.[385] The Puget Sound CAA's programs had previously allowed wood stoves as an option for changeout program participants, but the Agency determined that greater emissions reductions were needed.[386]

Some wood stove changeout programs have prioritized support for non-wood heating options.

- The *Fairbanks North Star Borough, Alaska* municipal code incorporates a changeout incentive structure that provides larger grants for pellet, gas, and propane devices, compared to cordwood stoves.[387] Moreover, at the programmatic level the Borough has established four zones based on air monitoring data, and has determined which replacement options are available for funding in each zone. In 2020, 264 changeouts were completed, and only seven involved conversion to solid fuel devices (wood or pellet).[388]

- The *New York* State Energy Research and Development Authority, which promotes wood as a renewable resource, provides incentives for changing to pellet stoves, but not to wood stoves. The new pellet stove must be EPA-certified as having emissions of 2.0 g/hr or less and an actual measured efficiency of 70 percent or greater.[389]

- Financial assistance for changeouts in *Oregon* emphasizes a transition to non-wood heating, with exceptions provided for lower-income households. *Washington County* operates a program that provides partial funding to replace an old wood stove with a heat pump, gas stove or insert, EPA-certified pellet stove or insert, or a gas furnace. Lower-income homes that qualify for a full-cost replacement grant may switch to one of these appliances or to an EPA-certified wood stove.[390] *Klamath County* recently received both state and federal funding for a large-scale changeout

[384] Air Safe Pierce County, Air On the Safe Side, http://www.airsafepiercecounty.org/wood-stove-program.
[385] Puget Sound Clean Air Agency, Puget Sound Wood Stove Program, https://pscleanair.gov/409/Wood-Stove-Program.
[386] ELI Communications with Puget Sound CAA Official (May 2020).
[387] Fairbanks North Star Borough Mun. Code §21.28.040.
[388] ELI Communications with Fairbanks North Star Borough Officials (March 2021). Alaska has received considerable funding for Borough changeouts in the past two years. U.S. EPA News Release: State of Alaska and Fairbanks North Star Borough Receive $5 Million EPA Grant to Improve Air Quality in Fairbanks (10/17/19), https://www.epa.gov/newsreleases/state-alaska-and-fairbanks-north-star-borough-receive-5-million-epa-grant-improve-air; Alaska DEC, Alaska Receives Grant to Improve Air Quality in Fairbanks and North Pole (11/30/20), https://dec.alaska.gov/commish/press-releases/20-13-alaska-receives-grant-to-improve-air-quality-in-fairbanks-and-north-pole/.
[389] NYSERDA, Residential Pellet Stoves, https://www.nyserda.ny.gov/All-Programs/Programs/Renewable-Heat-NY/Residential-Wood-Pellet-Stove (accessed 2/23/21).
[390] Washington County, Oregon, Wood Stove Exchange Program, https://www.co.washington.or.us/CommunityDevelopment/WoodStoveExchange/.

initiative to convert wood-burning residential heating devices to non-wood-burning devices such as gas inserts and ductless heat pumps. The program will be coupled with residential weatherization efforts to maximize heating efficiency and reduce costs for residents.[391]

- The 2017 law establishing *California's* wood smoke reduction funding program "prioritize[es] using incentive moneys on the most efficient, non-wood-burning devices, including, but not limited to, heat pumps and solar, electric, and natural gas heaters." If non-wood alternatives are infeasible or cost prohibitive, the program considers the "cleanest and best available technologies...including education on proper burn practices...." The most recent program guidelines allow EPA-certified (Step 2) heaters, along with natural gas or propane stoves or inserts, electric stoves, and ductless mini-split heat pumps.[392]

- The *Bay Area AQMD* recently implemented a wood stove changeout program that covers replacement to a natural gas- or propane-fueled heating stove or fireplace insert or an electric heat pump system, but does not fund new wood stoves or pellet stoves.[393]

- *Utah's* Wood Stove and Fireplace Conversion Assistance Program provides funding for households that use wood stoves or fireplaces for a significant amount of their heating. One program for nonattainment areas offers funding to convert to an electric ($1,000) or gas- or propane-fueled ($2,800) appliance; these amounts are increased for lower-income households ($2,000 and $4,000). Another program is limited to lower-income families only.[394]

Wood-Burning Best Practices. Emissions reduction programs also include financial or material assistance to implement best practices for wood burning – e.g., providing wood sheds and tarps for storing wood, subsidizing purchases of seasoned wood, or providing moisture meters to help ensure that only dry wood is burned.

The *Nez Perce Tribe* implemented an Elders' Air project that provided both education and different types of material assistance to senior and elder tribal members, including seasoned firewood via a tribal wood yard, moisture meters, stove thermometers, fire starters, and air cleaners. The program also built wood sheds for elders' homes and provided community classes on building a wood shed.[395]

---

[391] U.S. EPA, News Release: $1.8M EPA grant will provide woodstove alternatives and improve air quality in Klamath Falls, Oregon, https://www.epa.gov/newsreleases/18m-epa-grant-will-provide-woodstove-alternatives-and-improve-air-quality-klamath-falls (proposing to replace approximately 144 wood stoves with non-wood-burning devices over a 5-year period).

[392] Ca. Health & Safety Code §39733; Cal. Air Resources Bd., Woodsmoke Reduction Program Guidelines (2019), https://ww3.arb.ca.gov/planning/sip/woodsmoke/reduction_program.htm.

[393] BAAWMD, Wood Smoke Reduction Incentive Program, https://www.baaqmd.gov/funding-and-incentives/residents/wood-smoke-rebate.

[394] Utah Dept. of Envtl. Quality, Wood Stove and Fireplace Conversion Assistance Program, https://deq.utah.gov/air-quality/wood-stove-conversion-assistance-program (accessed 2/26/21).

[395] Nez Perce Tribe, ERWM Air Quality Program, Measurable Outcomes of a Woodstove Changeout on the Nez Perce Reservation - Final Performance Report (2009), available at: https://www.epa.gov/sites/production/files/2015-09/documents/nezpercereport.pdf; National Tribal Air Association, Status of Tribal Air Report May 2018 at 57-59, available at: https://7vv.611.myftpupload.com/wp-content/uploads/2019/12/2018-NTAA-STAR-compressed.pdf. See also K. L. Walters, et al., Growing from our roots: strategies for developing culturally grounded health promotion interventions in American Indian, Alaska Native, and Native Hawaiian communities. *Prevention Science, 21,*54-64 (2020), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6502697/ (describing Elders' Air project and other examples of research illustrating "strategies for designing and implementing culturally grounded models of health promotion developed in partnership with Native communities").

The *Lane Regional Air Pollution Agency* in Oregon has supported a Community Firewood Program in the city of Oakridge. Currently managed by Oakridge Air, the program sells affordable, well-seasoned firewood to homes that have a sole source or economic hardship exemption from burning restrictions, with 90 percent of wood sales going to lower-income, senior, or disabled community members.[396]

The *Puget Sound CAA* in Washington is running a pilot program, the Clean Burning Challenge, for residents of King, Kitsap, Pierce, and Snohomish Counties. Those who join the challenge (by reading tips on clean burning, passing an online quiz, and signing up for burn ban alerts) are mailed a clean burning kit that includes a moisture meter and information on burning and storing wood safely.[397]

Dedicated State Funds for Reducing Wood-Burning Emissions. Changeout programs require considerable funding. A large share is the subsidy for the new, lower-emitting heat source. The program also requires staff resources for administering the process and for providing outreach, an important component for ensuring proper use of the new devices.[398] A 2016 Oregon report noted that the state's "experience to date with woodstove changeouts shows this is a multi-year effort requiring sustained funding. The ongoing funding provides a level of continuity for communities to know there will be a multi-year funding source to do changeouts and to be part of the larger effort within the community to address wood smoke."[399]

Funding programs are commonly supported with government funds, often combined with other sources such as utilities, wood stove manufacturers, and non-governmental organizations.[400]

- *Washington* state has appropriated considerable funding for wood stove changeouts. The Local Partner Wood Smoke Reduction Grants program supports local clean air agencies and regional offices of the Department of Ecology for "projects that will protect people from breathing harmful smoke." Eligible projects include wood stove changeout programs, wood stove recycling programs (payments for destroying older stoves), and "other strategies approved by Ecology regional offices (where no local clean air agency exists)." In the current biennium, $2.5 million were made available through the state's Air Pollution Control Account.[401]

- *California* legislation enacted in 2017 created the state's *Woodsmoke Reduction Program* with the aim of promoting "voluntary replacement of old, uncertified wood-burning stoves with cleaner-burning and more energy-efficient alternatives in order to achieve short- and long-term climate

[396] Oakridge Air, Community Firewood Program, https://oakridgeair.org/firewood; Lane Regional Air Protection Agency, Oakridge Attainment Strategy, http://www.lrapa.org/259/Oakridge-Targeted-Airshed-Grant.
[397] Puget Sound CAA, Clean Burning Challenge, https://www.pscleanair.gov/622/Clean-Burning-Challenge; Puget Sound CAA, Memo to Board of Directors (11/12/20), available at: https://pscleanair.gov/AgendaCenter/ViewFile/Agenda/_11192020-154.
[398] See Nez Perce Tribe, ERWM Air Quality Program, Measurable Outcomes of a Woodstove Changeout on the Nez Perce Reservation - Final Performance Report (2009), available at: https://www.epa.gov/sites/production/files/2015-09/documents/nezpercereport.pdf. See also U.S. EPA, How to Implement a Wood Burning Appliance Changeout Program at 3 (2014), https://www.epa.gov/sites/production/files/2015-08/documents/howtoimplementawoodstovechangeout.pdf.
[399] Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 6, https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf.
[400] See generally, Database of State Incentives for Renewables & Efficiency (DSIRE), https://www.dsireusa.org/; Hearth, Patio and Barbeque Assoc., Woodstove Changeout, https://www.hpba.org/Promotional-Campaigns/Woodstove-Changeouts.
[401] Wash. Dept. of Ecology, Local Partner Wood Smoke Reduction Grants, https://ecology.wa.gov/About-us/How-we-operate/Grants-loans/Find-a-grant-or-loan/Wood-smoke-reduction-grants; ELI Communications with Ecology Officials (March 2021).

benefits and localized public health benefits."[402] The program is funded by legislative appropriations from the Greenhouse Gas Reduction Fund.[403] Funds were appropriated in the 2016-17 ($5 million) and 2018-19 ($3 million) budgets, for distribution to air districts participating in the program.[404]

- In 2009, *Maine* law established the *Residential Wood Stove Replacement Fund* as a non-lapsing fund administered by the state "for the purpose of providing financial incentives for the replacement of wood stoves with cleaner alternatives." The Fund prioritizes replacing pre-1988 residential wood stoves used as a primary source of heat with "residential heating appliances with lower emissions of pollution, such as wood stoves, pellet stoves or vented gas stoves."[405]

- *Oregon* law also establishes a special fund for wood smoke reduction. The *Residential Solid Fuel Heating Air Quality Improvement Fund* was created for the purpose of reducing emissions from solid fuel burning devices.[406] The law requires the Department of Environmental Quality to establish a program providing grants, loans, and other subsidies "for the replacement or removal of [solid fuel burning devices] that were not certified." Priority must be given to PM nonattainment areas and areas with "substantial risk of being designated" as a PM nonattainment area. The department's 2016 legislative report notes that Oregon has been conducting woodstove changeouts since the 1980s (especially in areas struggling to meet federal air quality standards), though there were still approximately 150,000 uncertified stoves remaining.[407] The agency's web page lists several local programs it is funding in the 2019-2021 biennium, totaling $450,000.[408]

A number of states have legislation and regulations that establish state *tax deductions or tax credits* to help finance the cost of heating systems.[409] Many of these programs cover the purchase of certified wood heaters as part of an incentive that is specific to solid fuel burning devices or that applies more generally to alternative (non-fossil fuel) energy systems.[410] Like *Idaho's* tax credit, these incentives could limit eligibility of wood heaters and pellet heaters to devices that meet current standards and that are replacing an older device, and could require the older stove to be surrendered to the state for destruction.[411] Tax credits could also prioritize the replacement of older wood stoves with lower-emitting heating appliances. The federal government also provides a *tax credit* for the purchase of new biomass heaters.[412]

Another potential source of financing for replacing older wood stoves are *property assessed clean energy* (PACE) programs, which allow property owners to access private capital to finance the cost of energy

[402] Ca. Health & Safety Code §39733.
[403] Id.; Ca. Govt. Code §16428.8.
[404] *See* Ca. Air Resource Bd., Wood Smoke Reduction Program, https://ww2.arb.ca.gov/our-work/programs/residential-woodsmoke-reduction/woodsmoke-reduction-program.
[405] 38 Maine Stat. §610-D.
[406] Or. Rev. Stat. §468A.490.
[407] Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 25 (2016), https://www.oregon.gov/deq/FilterDocs/SB3068Report.pdf.
[408] Oregon Dept of Envtl. Quality, Wood Stoves: Financial Assistance, https://www.oregon.gov/deq/Residential/Pages/Woodstoves.aspx.
[409] See NESCAUM, Assessment of EPA's Residential Wood Heater Certification Program at 8 (2021), https://www.nescaum.org/documents/nescaum-review-of-epa-rwh-nsps-certification-program-202103.pdf/.
[410] See, e.g., Mt. Stat. §15-32-201, Mt. Admin. Code §42.4.104.
[411] Idaho Stat. §63-3022C.
[412] Federal legislation enacted in December 2020 establishes a new tax credit to replace the current credit. See Consolidated Appropriations Act, 2021 - H.R. 133, §148; Hearth, Patio & Barbeque Assoc., Biomass Stove Tax Credit, https://www.hpba.org/Advocacy/Biomass-Stove-Tax-Credit.

efficiency and related improvements as an assessment on their property that is paid back as an addition to their property tax bill. State laws typically authorize PACE programs, which are established at the local level.[413] States and local governments could include wood stove replacement as an eligible qualifying improvement.[414]

Policy Strategy: Leverage Existing Federal/State Funding Programs

There are a variety of existing government funding programs in areas including housing, health, environment, and energy that could possibly be tapped to assist households in reducing emissions from wood-burning devices. Because relevant programs may be located under different authorities, communication among agencies is important for maximizing resources for wood stove changeouts. Oregon's 2016 legislative report, which discussed a range of financial assistance programs available within the state, underscored the point: "Coordination between agencies to combine assistance, potential funding, and resources gives communities more tools to address woodsmoke."[415]

This section describes some of the government funding programs that have been used to help support wood smoke reduction activities and that are potential sources for communities across the country. Non-governmental sources such as utilities are also an important resource, but are not described here.[416]

This section does not provide an exhaustive list of potential funding sources and cannot capture the wide variety of funding sources that jurisdictions have used to support initiatives to reduce wood-burning emissions. Other sources of information about funding include EPA's guide to financing options, as well as the Tribal Healthy Homes Network's Tribal Indoor Air Funding Directory, which is searchable by "Woodsmoke" and other topics.[417]

Following are short descriptions of some of the major programs that provide financial assistance to lower-income households for activities that could potentially include replacing wood-burning devices. Many states,

[413] See generally U.S. Dept. of Energy, Property Assessed Clean Energy Programs, https://www.energy.gov/eere/slsc/property-assessed-clean-energy-programs.
[414] Florida legislation introduced in 2021 would amend the state's PACE law to expressly allow improvements that mitigate "indoor air pollution or contaminants, including particulate matter." Fl. H.B. 387.
[415] Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 7 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf. The report detailed a number of local programs integrating various funding sources, such as the Lane Regional Air Protection Agency's Warm Homes Clean Air program, which combined wood stove buyout, weatherization, and home repair programs. Id at 25.
[416] For example, Lane Electric, an energy cooperative in Oregon, is currently offering $3,800 for qualifying ductless heat pump installation for low-income customers. Lane Electric, Current Programs, https://laneelectric.com/programs-services/current-programs/ (accessed 3/19/21). A 2010 report noted that there were "over 600 government and utility energy audit, rebate, loan, and grant programs" at the state and local levels. See Natl. Safe and Healthy Housing Coalition, Integrating Energy Efficiency and Healthy Housing at 1 (rev. 2010), http://www.nchh.org/Portals/0/Contents/Coalition_briefing_paper_energy.pdf.
[417] U.S. EPA, EPA's Guide to Financing Options for Wood-burning Appliance Changeouts, https://www.epa.gov/sites/production/files/2016-03/documents/epas_guide_to_financing_options.pdf; Tribal Healthy Homes Network, Tribal Indoor Air Funding Directory, https://tribalindoorairfunding.org/; Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 21-34 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf.

localities, and tribes currently implement the federal programs described below and may also have their own similar, separately funded programs.

Federal Clean Air Act Funding. Apart from tax credits, there are no federal funding programs designed exclusively for wood smoke reduction activities.[418] There are, however, federal clean air funding programs that have provided significant support for changeouts and related activities.

Targeted Airshed Grants. EPA's Targeted Airshed Grants program, authorized and funded through Congressional appropriations, has provided grants to "local, state, and/or tribal air pollution control agencies to develop plans and conduct projects to reduce air pollution in nonattainment areas that EPA determines are the top five most polluted areas" for PM and ozone.[419] The program has funded extensive changeout programs and other actions targeting emissions from wood-burning devices, including recent large awards to Alaska/Fairbanks and Oregon/Klamath Falls.[420]

Funding Under Clean Air Act Sections 103 and 105. EPA provides grants to state, local, and tribal air pollution control agencies to carry out their general responsibilities under the Clean Air Act. The grants, authorized under Sections 103 and 105 of the Act, have supported wood stove changeout projects in the past.[421] Section 105 authorizes grants to support the implementation of programs to prevent and control air pollution and address primary (health) and secondary (welfare) ambient air quality standards; the federal government may provide grants equaling up to 60 percent of the cost of state and local programs and 95 percent of the costs for eligible tribes**.** Section 103 grants support research, investigations, experiments, demonstrations, surveys, and studies for preventing and controlling air pollution, including specialized air monitoring programs.[422]

Energy Retrofits/Weatherization. Home energy retrofit programs represent an important opportunity for sustaining wood stove replacement programs. By integrating changeouts with other measures that increase a home's energy efficiency, programs can improve comfort and help reduce the cost of running new heating appliances.

Weatherization Assistance Program. The largest source of federal home energy efficiency funding is the Weatherization Assistance Program (WAP), run by the U.S. Department of Energy. 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

[418] Legislation introduced in Congress in 2019 focused specifically on funding actions to reduce emissions from wood heaters. See Wood Heaters Emissions Reduction Act (H. 5391, S. 2274).
[419] U.S. EPA, 2019 & 2020 Targeted Airshed Grant Program, https://www.epa.gov/grants/2019-2020-targeted-airshed-grant-program-closed-announcement-fy-2020 (accessed 3/19/21).
[420] U.S. EPA, News Release from Region 10 (12/9/20), https://www.epa.gov/newsreleases/18m-epa-grant-will-provide-woodstove-alternatives-and-improve-air-quality-klamath-falls; Alaska Public Media, Fairbanks Wood Stove Buyout Program Gets $5 Million Boost (10/23/19), https://www.alaskapublic.org/2019/10/23/fairbanks-wood-stove-buy-out-program-gets-5m-boost/.
[421] See U.S. EPA, EPA's Guide to Financing Options for Wood-burning Appliance Changeouts at 8, https://www.epa.gov/sites/production/files/2016-03/documents/epas_guide_to_financing_options.pdf
[422] 42 U.S. Code §§7403, 7405. See also U.S. EPA, Tribal Authority Rule under the Clean Air Act, https://www.epa.gov/tribal-air/tribal-authority-rule-tar-under-clean-air-act. EPA's Indiana Environmental General Assistance Program might be another source of funding for tribal activities relating to wood-burning that "[support] the planning, developing and establishing phases of a tribal environmental program...." U.S. EPA, EPA's Indian Environmental General Assistance Program (GAP) Frequently Asked Questions (FAQs) at 8, https://www.epa.gov/sites/production/files/2019-12/documents/gap_faq_november_2016_0.pdf.

are particularly vulnerable such as the elderly, the handicapped, and children."[423] 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 non-profit organizations to implement weatherization projects.

Weatherization programs are an opportunity to address indoor air quality in the home.

The Weatherization Assistance Program takes a "whole house" approach to energy efficiency that addresses the building envelope, heating and cooling systems, and certain appliances, and includes a health and safety component. WAP program guidance indicates whether certain health and safety actions are required, allowed, or prohibited. In addition to required combustion safety measures, WAP guidance provides that *replacement* of solid fuel space heaters (wood stoves, coal stoves, pellet stoves, and fireplaces) is an allowable health and safety measure if the appliance is the *primary* heat source. *Repair or removal* is allowed for both primary and secondary heat sources, while repair of flues and proper installation is required for both primary and secondary heating appliances."[424]

Because replacement of primary-source wood heaters is allowed (though not required), grantees can specify this as an allowable use of WAP funds in their program guidance and can specify the types of devices that may be installed as replacements using WAP funds.[425] Grantees can also prioritize WAP funding for non-wood-burning alternatives, where feasible. For example, *Utah*'s current WAP guidelines state that replacement of wood- or pellet-burning stoves "should only be considered if it is not reasonable to connect to local utilities or other extenuating circumstance as approved by Housing and Community Development."[426] Additionally, WAP guidance requires households receiving a new wood stove to be given information on the safe operation and proper maintenance of the device, and grantees could emphasize or augment this component in their weatherization plans.[427]

Housing Development and Repair. Federal agencies administer a variety of loan-only programs for homeowners, which could be used to replace older wood heaters with lower-emitting sources of heat for the household.[428] Following are some of the primary federal programs offering *grants* that could be used for this purpose.

Community Development Block Grant (CDBG). The CDBG program, administered by the U.S. Department of Housing and Urban Development (HUD), is the largest source of funding for housing and

[423] 42 U.S.C. §6861.
[424] U.S. Dept. of Energy, WPN 17-7: Weatherization Health and Safety Guidance Attachment A at 3, and WPN 17-7 Table of Issues – Table of Contents at 2, available at: https://www.energy.gov/eere/wap/downloads/wpn-17-7-weatherization-health-and-safety-guidance.
[425] See, e.g., Wash. Dept. of Commerce, Weatherization Manual For Managing the Low-Income Weatherization Program (rev. 2010), https://nascsp.org/wp-content/uploads/2018/02/WA-WeatherizationManualforManagingheLow-IncomeWeatherizationProgram.pdf; State of Montana, 2020 Weatherization Manual at 66, https://dphhs.mt.gov/Portals/85/hcsd/documents/lieap/WeatherizationManual.pdf.
[426] State of Utah, Utah Weatherization Assistance Program Guidelines at 64 (2020), https://jobs.utah.gov/housing/scso/wap/iwtc/utahweatherizationguidelines.pdf. This is only allowed where wood burning is the sole source of heat.
[427] U.S. Dept. of Energy, Memo to Support Office Directors: Approval to Include Wood Stoves As a Weatherization Assistance Program Material at 2 (Aug. 4, 1988); U.S. Dept. of Energy, Weatherization Assistance Program Briefing Book at 21 (2019), https://www.energy.gov/sites/prod/files/2020/01/f70/wap_briefing_book_v2.4_01.2020.pdf.
[428] See, e.g., HUD, 203(k) Rehabilitation Mortgage Insurance, https://www.hud.gov/program_offices/housing/sfh/203k; U.S. Dept. of Energy, Energy Efficient Mortgages, https://www.energystar.gov/newhomes/mortgage_lending_programs/energy_efficient_mortgages.

economic development activities serving low- and moderate-income communities.[429] HUD awards CDBG funds to states, tribes, and entitlement communities (localities), which in turn distribute the funds to projects in accordance with federal regulations. Priorities for distributing funds are incorporated into CDBG planning documents, which must be developed with community participation.[430]

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." Grantees have "flexibility under the CDBG Program to design repair and rehabilitation programs that meet the needs of their residents" and thus can set up a program with CDBG funding to support emergency repairs, weatherization, and other activities that might include improvements to heating systems in lower-income households. Grantees can also provide similar assistance for the rehabilitation of rental housing.[431]

Indian Community Development Block Grant. HUD's Indian Community Development Block Grant program funds tribes, Alaska Native villages, and tribal organizations to support housing rehabilitation and other activities to benefit low- and moderate-income households. Eligible housing rehabilitation activities include energy efficiency improvements such as replacement of heating equipment and "replacement of principal fixtures and components of existing structures." In addition, HUD may set aside five percent of annual program funding for grants to eliminate or lessen problems that pose an imminent threat to public health or safety of tribal residents.[432]

*Indian Housing Block Grant***.** HUD's Indian Housing Block Grant program provides funding to tribes to "develop, operate, maintain, or support affordable housing for rental or homeownership, or to provide housing services with respect to affordable housing," including moderate or substantial rehabilitation and energy efficiency improvements.[433]

Section 504 Home Repair Program. The U.S. Department of Agriculture (USDA) manages programs that fund the repair and development of affordable housing in rural areas. One of the largest is the Single Family Housing Repair Loans and Grants program, also known as the Section 504 Home Repair Program, which provides grants and loans to very-low-income homeowners. Grants up to $7,500 may be used by elderly homeowners to remove health and safety hazards, which might potentially include older wood-burning devices. Low-interest loans up to $20,000 may be used more broadly to repair, improve, or modernize homes.[434]

Utility Assistance: The Low-Income Home Energy Assistance Program*.* Energy assistance programs can also be an important component of a coordinated effort to reduce emissions from wood heaters. The largest national energy assistance program is the federal Low-Income Home Energy Assistance Program (LIHEAP). All 50 states, the District of Columbia, several U.S. territories, and over 150 tribes and tribal organizations

[429] 42 U.S.C. §§5301 et seq.; 24 C.F.R. Pt. 570.
[430] Documents that must be submitted to HUD include an Annual Action Plan and a three- to five-year Consolidated Plan. 24 C.F.R. 570.302, 24 C.F.R. Pt. 91.
[431] 6 HUD, Basically CDBG, ch. 4, §§4-1, 4-2, 4-5 (2012), available at https://www.hudexchange.info/resource/19/basically-cdbg-training-guidebook-and-slides/.
[432] 24 CFR 1003.202(b), .103.400; HUD, Indian Community Devt. Block Grant Program, http://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/ih/grants/icdbg.
[433] 25 U.S. Code §4132, 24 CFR 1000.102. See generally HUD, Indian Housing Block Grant Program, http://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/ih/grants/ihbg.
[434] See USDA, Single Family Housing Repair Loans & Grants, https://www.rd.usda.gov/programs-services/single-family-housing-repair-loans-grants.

receive LIHEAP block grants from the U.S. Department of Health and Human Services each year. Grantees in turn distribute the funds to eligible households.[435]

LIHEAP block grant funds are to be used to help households meet the costs of "home energy," defined broadly as "a source of heating or cooling in residential dwellings."[436] Funds may be used to pay utility bills, repair and upgrade heating devices, and provide weatherization. In some states, assistance is provided only to the primary heating source.[437] LIHEAP funds could be used to repair or replace wood heaters or purchase seasoned wood for lower-income households that use wood as a primary heat source. For lower-income households that use wood as a secondary heat source, the program could subsidize winter utility bills (e.g., gas, electric, oil) to help reduce reliance on wood-burning devices.

Jurisdictions could craft their annual LIHEAP plans to include wood stove replacement, and some have done so.[438] Because most LIHEAP plans and programs already include "heating system replacement" as an eligible cost, there might be circumstances in which a jurisdiction could allow the replacement of a wood stove with a non-wood heating source even where the program plan does not expressly include purchase of a wood stove.[439]

Montana is an example of a state that includes wood stove changeouts as an eligible activity in its regulations governing the LIHEAP program. The state's LIHEAP emergency assistance funds may be used to replace a non-certified wood stove if the household uses the stove as its primary heat source and is eligible to receive a benefit award for wood during the heating season.[440] A number of jurisdictions have created pilot or other special programs using LIHEAP funds, often in combination with other funding sources, to assist low-income households with changeouts.[441]

Healthy Homes/Asthma Programs. Many public health agencies and non-governmental organizations throughout the U.S. implement healthy homes programs to address environmental health problems in homes, with a special focus on reducing home asthma triggers. The programs may include in-home assessments, education about behavior change, and minor equipment or modifications in the home.[442]

In recent years, there have been notable efforts to identify sustainable funding sources for implementing healthy homes interventions, including the development of innovative health care financing strategies to pay

[435] 42 U.S.C. §§8621-8630; U.S. Dept. of Health & Human Svcs., LIHEAP Fact Sheet (2018), https://www.acf.hhs.gov/ocs/resource/liheap-fact-sheet-0.
[436] 42 U.S.C. §§8622(6), 8624(b)(1).
[437] U.S. Dept. of Health & Human Svcs., LIHEAP FAQs for Consumers, https://www.acf.hhs.gov/ocs/faq/liheap-faqs-consumers.
[438] See, e.g., Mo. Dept. of Social Services, FFY20-21 LIHEAP Model State Plan at 14, https://dss.mo.gov/fsd/energy-assistance/pdf/missouri-liheap-ffy2021-model-state-plan-draft.pdf; Colorado LIHEAP Detailed Model Plan 2020-2021 at 14, https://liheapch.acf.hhs.gov/sites/default/files//webfiles/docs/CO_Plan_2021.pdf; West Virginia LIHEAP Detailed Model Plan 2020-2021 at 14, https://liheapch.acf.hhs.gov/sites/default/files//webfiles/docs/WV_Plan_2021.pdf.
[439] See generally, U.S. Dept. of Health & Human Svcs., LIHEAP State and Territory Plans, Manuals, and Delegation Letters, https://liheapch.acf.hhs.gov/stateplans.htm.
[440] Mt. Admin. Code §37.70.901(8). Emergency assistance under LIEAP may be provided to an eligible "when such circumstances present an imminent threat to the health and safety of the household." Id. §37.70.901(1).
[441] See LIHEAP Clearinghouse, Issue Brief: Wood Stove Changeouts and LIHEAP (2103), https://liheapch.acf.hhs.gov/sites/default/files/webfiles/docs/WoodStoveChangeouts.pdf; Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 7 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf.
[442] HUD, Guide to Sustaining Effective Asthma Home Intervention Programs (2018), https://www.hud.gov/sites/dfiles/HH/documents/HUD%20Asthma%20Guide%20Document_Final_7_18.pdf.

for preventive services not traditionally covered by medical insurance.[443] Even if healthy homes programs do not have funds to replace wood heaters, they might potentially fund more modest interventions to reduce wood smoke emissions – e.g., education on cleaner burning practices, wood stove repairs, or equipment such as moisture meters or wood sheds. They could also be important in referring households to other funding programs.

In addition, healthy homes programs and interventions could include a portable air cleaner as part of the supplies they provide clients.[444] As noted in Part One, using the proper size and type of air cleaner (and one that does not produce ozone) has been shown to be effective at reducing pollutant levels in homes, including pollutants from wood burning. Educating clients on proper use and maintenance of the air cleaner (e.g., regular filter replacement) is important for ensuring that the equipment functions as intended. In 2018, EPA published a guide that provides tips for selecting and using a portable air cleaner.[445]

In some jurisdictions, healthy homes programs and interventions are integrated with the weatherization program. This collaboration is vital for maximizing health and safety measures as part of the weatherization project and for making sure that energy efficiency retrofits adequately address ventilation and other considerations, to avoid inadvertently increasing levels of wood smoke and other pollutants generated inside the home.

Supplemental Environmental Projects. A Supplemental Environmental Project (SEP) is an environmentally beneficial project that a defendant voluntarily agrees to undertake as part of the settlement of an environmental enforcement case. SEPs must generally reduce the impact of the violation on public health or the environment, and they cannot be projects that the violator is already required to do. SEPs are not government funding programs per se, but they have been a frequent source of support for wood stove changeout programs.[446] The U.S. EPA and many states have issued guidance on SEPs, and some states maintain lists of projects that could potentially be funded through a SEP. *Indiana* is an example of a state that includes wood stove changeouts in its list of potential SEP projects under the category, "Reduce Air Pollutants that Contribute to Respiratory Illness."[447]

[443] See generally Green & Healthy Homes Initiative, Sustainable Funding and Business Case for GHHI Home Interventions for Asthma Patients (2015), https://www.greenandhealthyhomes.org/publication/sustainable-funding-business-case-ghhi-home-interventions-asthma-patients-2/; Natl. Center for Healthy Homes, Medicaid 101, https://nchh.org/tools-and-data/financing-and-funding/healthcare-financing/medicaid-101/.

[444] HUD, Guide to Sustaining Effective Asthma Home Intervention Programs (2018), https://www.hud.gov/sites/dfiles/HH/documents/HUD%20Asthma%20Guide%20Document_Final_7_18.pdf.

[445] U.S. EPA, Guide to Air Cleaners in the Home, 2d ed. (2018), https://www.epa.gov/sites/production/files/2018-07/documents/guide_to_air_cleaners_in_the_home_2nd_edition.pdf.

[446] See, e.g., Oregon Dept. of Envtl. Quality, Woodsmoke in Oregon: House Bill 3068 - 2015 Final Report to Legislature at 30 (2016), https://www.oregon.gov/deq/FilterDocs/WoodsmokeOR.pdf (describing several SEPs, including one in Klamath Falls that where 66 stoves were removed and replaced with non-wood-burning devices); Navajo Nation EPA, Implementing a Tribal Indoor Air Quality Program, https://www.env.nm.gov/wp-content/uploads/sites/2/2016/11/Navajo-Nation-EPA-Tribal-IAQ-Program-10-23-18_FCAQG-Mtg.pdf (describing SEP providing $ 4.7 million to replace older wood and coal stoves with cleaner burning heating appliances and to weatherize homes in the Navajo Nation).

[447] Indiana Dept. of Envtl. Mgmt., Supplemental Environmental Project (SEP) Idea Library at 8.3.3 (2013), https://www.in.gov/idem/legal/files/enforcement_sep_idea_library.pdf.

APPENDIX

Citations to Laws and Regulations Discussed in Part Two

The following chart includes the laws and regulations discussed in the report that address directly the goal of lowering emissions from wood-burning devices. Policies noted in the text that are of a more general scope – e.g., general nuisance provisions – are not included in this chart. The footnotes throughout the report include citations to each policy provision described in the text. As noted at the outset, the report does not include all policies at the state, local, or tribal levels that address emissions from wood-burning devices.

STATES			
Jurisdiction	Statute/Law	Regulation	URL
Alaska		18 Ak. Admin. Code §§50.075-50.076 18 Ak. Admin. Code §50.246	http://www.legis.state.ak.us/basis/aac.asp#2.05
Arizona	Az. Stat. §§11-871, -875	Az. Admin. Code, Maricopa County Air Poll. Control Reg. III, R. 300, §300	https://www.azleg.gov/arsDetail/?title=11 https://azsos.gov/rules/arizona-administrative-code
California	Ca. Health & Safety Code §39733 Ca. Gov't Code §16428.8		https://leginfo.legislature.ca.gov/faces/codes.xhtml
Colorado	Co. Stat. §§25-7-401--413	5 Co. Admin. Code 1001-6 (Reg. No. 4)	https://leg.colorado.gov/agencies/office-legislative-legal-services/colorado-revised-statutes https://www.sos.state.co.us/CCR/Welcome.do
Connecticut	Ct. Gen. Stat. §19a-206(a)	Ct. Admin. Code §22a-174-18(c)(2) Ct. Admin. Code §19-13-B2	https://www.cga.ct.gov/current/pub/chap_368e.htm#sec_19a-206 https://eregulations.ct.gov/eRegsPortal/Browse/RCSA/Title_22aSubtitle_22a-174_HTML/
Maine	38 Me. Stat. §610-D	06-96 Me. Rules ch. 150 §§2, 5	http://legislature.maine.gov/statutes/38/title38sec610-D.html https://www.maine.gov/sos/cec/rules/06/chaps06.htm

Montana	Mt. Stat. §15-32-201	Mt. Admin. Code §42.4.104 Mt. Admin. Code §37.70.901(8)	https://leg.mt.gov/statute/ http://www.mtrules.org/
New York		6 N.Y. Admin. Code §§211, 247.3	https://govt.westlaw.com/nycrr/Browse/Home/NewYork/NewYorkCodesRulesandRegulations?guid=Iad78c1b0b5a011dda0a4e17826ebc834&originationContext=documenttoc&transitionType=Default&contextData=(sc.Default)
Oregon	Or. Rev. Stat. §§468A.460--.515, 105.464	Or. Admin. Code §340-262-0400--1000	https://www.oregonlegislature.gov/bills_laws/Pages/ORS.aspx https://secure.sos.state.or.us/oard/ruleSearch.action
Texas		Tx. Admin. Code §111.111	https://texreg.sos.state.tx.us/public/readtac$ext.ViewTAC?tac_view=4&ti=30&pt=1&ch=111
Utah		Utah Admin. Code §R307-302	https://rules.utah.gov/publications/utah-adm-code/
Vermont		Vt. Admin. Code 12-031-001 §5-204	https://bit.ly/2PdNJMd
Washington	Rev. Code Wash. ch. 70a.15.3500—3630	Wash. Admin. Code §§173-433- 010--200; Wash. Admin. Code chs. 51-50, 51-51	https://apps.leg.wa.gov/rcw/ https://apps.leg.wa.gov/wac/default.aspx?cite=173

CITIES/COUNTIES			
Jurisdiction	**Statute/Law**	**Regulation**	**URL**
Albuquerque/ Bernalillo County (NM)		N.M. Admin Code §20.11.22	http://164.64.110.134/nmac/T20C011
Chico (CA)	Mun. Code ch. 8.32		https://codelibrary.amlegal.com/codes/chico/latest/chico_ca/0-0-0-7086#JD_Chapter8.32
Cottonwood (AZ)	Mun. Ord. ch. 8.56		https://library.municode.com/az/cottonwood/codes/code_of_ordinances?nodeId=TIT8HESA_CH8.56REFIWORNDE
Davis (CA)	Mun. Code §23.01.030		https://qcode.us/codes/davis/
Fairbanks North Star Borough (AK)	Borough Code ch. 21.28		https://fnsb.borough.codes/FNSBC/21.28

Klamath County (OR)	County Ord. 63.06		https://www.klamathcounty.org/1058/Klamath-County-Ordinances
Laguna Beach (CA)	Mun. Code §14.86.012		https://qcode.us/codes/lagunabeach/
Libby (MT)	Mun. Code §§8.12.070 -.140		https://library.municode.com/mt/libby/codes/code_of_ordinances?nodeId=TIT8HEWE_CH8.12COAIPO
Lincoln County (MT)		Lincoln County Envtl. Health Regs. ch. 75.1	http://www.lincolncountymt.us/images/departments/environmental_health/pdf/air_quality/AirOrdinanceRev_10MAY2017.pdf
Maricopa County (AZ)		Maricopa County Air Pollution Reg. P-26; Air Pollution Reg III, Rule 300	https://www.maricopa.gov/DocumentCenter/View/2016/P-26---Residential-Woodburning-Restriction-Ordinance-PDF https://www.maricopa.gov/DocumentCenter/View/5353/Rule-300---Visible-Emissions-PDF?bidId=
Marin County (CA)	Mun. Code ch. 19.08		https://library.municode.com/ca/marin_county/codes/municipal_code?nodeId=TIT19MACOBUCO
Missoula City/County (MT)		Missoula City-County Air Rules ch. 9	https://www.missoulacounty.us/home/showdocument?id=4124
Multnomah County (OR)	Mun. Code §21.450--.458		https://multco.us/county-attorney/multnomah-county-code
New York City (NY)		NYC Admin. Code t. 24, ch. 1, subch. 1, 6, 9.	https://codelibrary.amlegal.com/codes/newyorkcity/latest/NYCadmin/0-0-0-43362
Portola (CA)	Mun. Code ch. 15.10		https://library.municode.com/ca/portola/codes/code_of_ordinances?nodeId=TIT15BUCO_CH15.10WOSTFIORPROPBUYAWA
Salt Lake County (UT)		Salt Lake County Health Reg. #35	https://slco.org/health/regulations/
Washoe County (NV)		Washoe County Health Regs. (Air Quality) §040.051	https://www.washoecounty.us/health/files/air-quality/Current%20Regulations/040.051-Wood-burning%20Devices_20191003.pdf
REGIONAL AIR DISTRICTS			
Jurisdiction	**Statute/Law**	Regulation	URL
Bay Area AQMD (CA)		Regulation 6, Rule 3	https://www.baaqmd.gov/~/media/dotgov/files/rules/regulation-6-rule-3/documents/20191120_r0603_final-pdf.pdf?la=en

Mendocino County APCD (CA)		Regulation 4.1	http://www.co.mendocino.ca.us/aqmd/district-rule-4-1.html
Placer County APCD (CA)		Rule 225	https://www.placer.ca.gov/1861/Rules
Puget Sound Clean Air Agency (WA)		Regulation I, Art. 13	https://pscleanair.gov/219/PSCAA-Regulations
San Joaquin Valley Unified APCD (CA)		Rule 4901	https://www.valleyair.org/rules/1ruleslist.htm#reg4
South Coast AQMD (CA)		Rule 445	http://www.aqmd.gov/home/rules-compliance/rules/scaqmd-rule-book/regulation-iv
Tahoe Regional Planning Agency (CA/NV)	Code of Ord. §65.1.4		https://www.trpa.org/wp-content/uploads/TRPA-Code-of-Ordinances.pdf
TRIBES			
Jurisdiction	Statute/Law	Regulation	URL
Swinomish Indian Tribal Community	Swinomish Tribal Code §19-02		https://swinomish.org/government/tribal-code.aspx
Yurok Tribe	Yurok Tribal Code (Air Quality) §21.05		https://yurok.tribal.codes/YTC
FEDERAL			
Agency	Statute/Law	Regulation	URL
Environmental Protection Agency		40 CFR Subpart AAA (Wood heater rule)	https://www.govinfo.gov/app/details/CFR-2005-title40-vol6/CFR-2005-title40-vol6-part60-subpartAAA
Environmental Protection Agency		40 CFR Pt. 49, Subpts C, M (Federal Air Rules for Reservations)	https://www.ecfr.gov/cgi-bin/text-idx?node=pt40.1.49

1730 M Street, NW, Suite 700
Washington, DC 20036
Tel: 202.939.3800
Fax: 202.939.3868
www.eli.org