Wood-burning Stoves Raise New Health Concerns

Officials increasingly treat woodsmoke pollution as a potentially cancer-causing public health and environmental justice issue.

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When Susan Remmers moved into her home in Portland, Oregon, she thought she'd live there for the rest of her life. Remmers, a 58-year-old with a mobility disability, planned to outfit the house with ramps to be wheelchair accessible, and she viewed her 2012 purchase as an investment in her and her partner's future. But within months of moving in, she noticed grey smoke billowing from the chimney of the house next door. Next, she says, came the sore throats, headaches, and tight lungs.

Remmers had no history of respiratory issues, but by 2016 she ended up in the emergency room in the middle of the night when she had trouble breathing. She was pretty sure that the source was the smoke, and says that she asked her neighbor to stop burning wood for heat. But he kept doing it, as did other neighbors in her quiet residential neighborhood on the city's northeast edge. Now, almost 10 years after moving in, Remmers is desperately trying to leave the home she once saw as a haven.

Each time she has tried to move, potential new neighborhoods have had woodsmoke, too, from a restaurant with a wood burning oven to another neighbor burning, Remmers told Undark in a recent phone call from her house, where she runs three medical-grade air filters almost constantly to deal with the smoke. "It just seems more can be done," she added. "And people need to be aware of the harm."

Even with increasing electrification and natural gas infrastructure, wood burning has remained a fixture of American life. In the United States, 11.5 million homes, or about 30 million people, were estimated to use wood as their primary or secondary heat source, according to 2009 data from the U.S. Energy Information Administration, a figure that's increased in recent years along with rising costs of fuel oil. And although air pollution standards for major emitters like cars and factories have tightened, woodsmoke has remained relatively unregulated.

Many people don't see a risk. "It doesn't really seem like too much of a concern for me, certainly compared to other forms of pollution," says Chris Lehnen, a resident of Keene, New Hampshire, who relies on a wood boiler for heat. "You know, you have big cities and people dealing with smog

and all that stuff. That's got to be worse."

It's a common misconception, said Brian Moench, a doctor and president of Utah Physicians for a Healthy Environment, a nonprofit organization focused on pollution and public health. "Nothing could be further from the truth."

In reality, growing scientific evidence shows that woodsmoke affects human health and contributes to air pollution. Some cities and scientists are also tackling woodsmoke as an environmental justice issue by tracking its disproportionate impact on low-income residents and communities of color, who are already burdened with other forms of air pollution. Their work reveals that residential wood burning isn't just a rural habit, and that even a small number of urban stoves and fireplaces can have far-reaching consequences.

The effort to regulate and reduce residential wood burning, though, has run into opposition from industry. Unclear federal guidance hasn't helped: The Environmental Protection Agency is embroiled in a controversy over its process for determining the safety of consumer wood-burning appliances. Meanwhile, some states have spent millions of dollars replacing wood stoves with newer models — which may still be damaging to human health, an Undark examination has found. And agencies and advocates who are attempting to phase out residential wood heating entirely are brushing up against others who see wood as an inevitable part of the country's fuel mix, and believe that any reduction in pollution represents progress.

Meanwhile, residents like Remmers are left with little recourse. "Air is ubiquitous, and we can't control the air we breathe," she said. "In my view, it's criminal that we allow people to be put in a position where they have to poison themselves and their neighbors in order to stay warm."

Burning wood releases a host of particles and gases. The most regulated is fine particulate matter, or PM2.5 — particles 2.5 microns or smaller across, tiny enough to enter the bloodstream through the lungs and even penetrate the brain. But woodsmoke also contains carbon monoxide, nitrogen oxides, carcinogenic compounds like polycyclic aromatic hydrocarbons, or PAHs, and volatile organic compounds, or VOCs. Depending on what's being burned, wood stoves and fireplaces may even spit out toxic metals like mercury and arsenic.

The health effects of both short- and long-term exposure to these chemicals can be serious. Inhaling woodsmoke raises the risk of developing asthma, lung disease, and chronic bronchitis, according to the EPA, and can aggravate these conditions in people who already have them. Exposure to fine particulate matter from burning wood can also harm the body's respiratory immune response, increasing the risk of a respiratory infection — including Covid-19. And in the long run, compounds in woodsmoke can have carcinogenic effects that go beyond lung cancer; in 2017, researchers at the National Institutes of Health found that indoor wood-smoke pollution increases the risk of breast cancer.

The biggest health risks fall on children, as well as people who are older, pregnant, or who have preexisting medical conditions. A 2015 article in the journal Environmental Health Perspectives estimated that in the U.S., approximately 4.8 million vulnerable people live in homes with

“substantial exposures” to particulate matter from wood stoves, while a 2022 study found that even low levels of PM2.5 pollution can be deadly for older Americans.

“The important thing to understand about woodsmoke is it’s probably the most toxic type of pollution that the average person ever inhales,” said Moench, who also runs an advocacy group called Doctors and Scientists Against Wood Smoke Pollution. “When virtually any single particulate pollution that a person inhales can get distributed and end up in any organ system in the body, you can start to grasp that the disease potential is almost limitless.”

Although the potential health impacts of wood burning are well known, the direct effects are harder to measure, mainly because it’s difficult to trace respiratory ailments or cancers to a single source. But in a 2017 study, researchers from Boston and North Carolina estimated that residential combustion causes 10,000 premature deaths in the U.S. every year, mainly from woodsmoke.

Woodsmoke exposure isn’t uniform, though. Open hearths and fireplaces provide the greatest direct exposure, Moench said, while wood-burning stoves emit pollutants when they’re opened for refueling, as well as through leaks. The type of wood burned matters too — cordwood, the kind people chop themselves or buy in bundles at the grocery store, releases more smoke, especially when it’s damp, while wood pellets made from heated and compressed sawdust release less particulate matter, according to the EPA.

The broader community is affected, too. Wood stoves and fireplaces, as well as outdoor wood boilers that send heated water into a house, release smoke through chimneys and vents and contribute to ambient air pollution. Outdoor fire pits spew soot directly into the air, which a gust of wind can blow towards a nearby home. Together, these sources create a wintertime haze, particularly during inversion events, when cold air sinks to a valley floor, trapping woodsmoke in a town or neighborhood. That smoke can enter homes through windows and gaps in the insulation, as well as under doors — making people dependent on their neighbors for the air they breathe.

Nationwide, woodsmoke from residential burning contributes about 6 percent of all fine particulate matter emissions, according to the EPA’s 2017 National Emissions Inventory. But that number varies widely based on the time of year and location; communities in the Northeast, Northwest, and Mountain West experience some of the highest pollution levels, especially in the winter. Residential wood burning makes up the largest source of wintertime particulate matter in urban centers like the Bay Area of California — even though few residents there burn wood as their main source of heat — as well as rural towns in Montana, where wood burning is more of a necessity. Across western states every winter, according to the EPA, between 11 and 93 percent of PM2.5 emissions comes from people burning wood in residential areas.

Even within a city or town, the effects of woodsmoke may not be equally distributed. Across the country, air pollution, including PM2.5 emissions, disproportionately harms low-income communities and communities of color. A 2021 national study on racial disparities in PM2.5 exposure suggested that residential wood combustion wasn’t a major factor, but the research only considered ambient air quality, not indoor air pollution. On the other hand, a study of urban

woodsmoke conducted in Vancouver, Canada, from 2004 to 2005 found that higher-income areas have lower woodsmoke PM2.5 concentrations and residents end up inhaling a smaller fraction of the particles that are emitted, likely due to denser housing in lower-income areas.

City- and countywide data don't show the full picture of woodsmoke's disproportionate effects, said Robin Evans-Agnew, an expert in community health at the University of Washington Tacoma. Often, woodsmoke's damage is hyperlocal, with citywide air monitoring unable to capture how it drifts and lingers in a particular neighborhood. And communities that are already overburdened with pollution from other sources — like diesel emissions or industrial air pollution — feel the effects of woodsmoke pollution more strongly even if they're experiencing less of it.

"If I'm living in a low-income area in an urban community, I'm going to be getting just as much woodsmoke exposure as my wealthier neighbors, who have better access to health care, who have better access to physicians and doctors who can help them with their particular woodsmoke related health diseases," Evans-Agnew said.

While research from the Energy Information Administration shows that a greater percentage of higher-income households burn wood overall, lower-income households that do burn wood tend to consume more of it — indicating that wealthier people use fireplaces and stoves for ambience, while those who can't afford more expensive fuels turn to wood out of necessity. This can be particularly true in many rural and tribal communities, including the Navajo Nation, where indoor air pollution is a major cause of respiratory infections in young children.

Much of the work to address woodsmoke pollution, though, is conducted in cities. Oregon's Department of Environmental Quality considers woodsmoke to be an environmental justice issue in Portland, where residential wood combustion is the biggest source of air toxins for the Hispanic and Latino population.

That disparity is visible in Cully, a largely low-income neighborhood in Northeast Portland close to Remmer's home — and one of the most diverse areas of a majority-White city. Here, many older homes rely on wood for heat, said Oriana Magnera, an energy and climate policy coordinator for Verde, a local nonprofit that promotes environmental health. Verde has urged the state to fund programs that would replace wood stoves with electric heat pumps, particularly for low-income families.

The neighborhood is already polluted from industrial sources, Magnera said, and the people there have high rates of asthma. Woodsmoke, Magnera added, "just has a really detrimental impact on a community that is already facing many compounding challenges and intersecting issues."

To learn more about these disparities, some communities are turning to focused monitoring programs and citizen science projects. In Tacoma, Washington, in 2015, Evans-Agnew provided teenagers with air monitors to track pollution levels within their own homes rather than relying on ambient air quality measures for an entire town or area. And in Keene, a town of 23,000 in southwestern New Hampshire that has experienced heavy wintertime air pollution from woodsmoke for years, researchers like Nora Traviss — an environmental scientist at Keene State

College — are outfitting homes with PurpleAir monitors, small and relatively low-cost sensors that contribute real-time air quality data to a digital map.

The push for more data comes as more states and municipalities recognize that residential wood burning affects both indoor and outdoor air quality. Voluntary programs that offer financial incentives to swap older wood stoves for those that are newer — and, theoretically, cleaner-burning — had been implemented in at least 34 states and cities, as of 2016, according to the nonprofit Alliance for Green Heat, while the federal government offers a 26 percent tax credit for homeowners who install more efficient biomass heating systems. Many states and air quality agencies, as well as the EPA, also promote educational programs explaining how to burn wood properly and reduce emissions.

Some cities have taken more stringent measures, instituting burn bans when air pollution is high and even banning the installation of wood-burning appliances in new homes. But officials are often limited in what they can do unless air quality becomes so hazardous that it's no longer meeting federal standards — a designation known as non-attainment, meaning the area isn't in compliance with the Clean Air Act.

Fairbanks, Alaska was designated a non-attainment area in 2009, when PM2.5 air concentrations exceeded the federal 24-hour standard. The major sources, according to the Alaska Department of Environmental Conservation, were "local emissions from wood stoves" combined with weather patterns that hold smoke in place. In response, officials took a heavier-handed approach than most other municipalities have been able to do. The Fairbanks North Star Borough at first implemented a voluntary wood stove changeout program, providing funding for people who wanted to replace their older stoves.

Then, in October 2020, the government began requiring all stoves older than 25 years to be removed within the non-attainment area by 2024, unless they could meet strict standards for PM2.5 emissions. Since 2010, the first year data was collected after the voluntary changeout program began, 3,216 stoves have been replaced. Most were updated wood heating appliances, but in recent years, they've trended almost entirely to oil- and gas-powered devices. Fairbanks remains in non-attainment — and received the dubious moniker of "most polluted city" in the category of particle pollution in the American Lung Association's 2021 State of the Air report — but it's seen a reduction in air pollution levels by about half, said Cindy Heil, a program manager at the Alaska Department of Environmental Conservation.

Other programs have shown mixed results. Between 2005 and 2007, the Hearth, Patio, and Barbecue Association, a group that represents the wood stove industry, along with the EPA and the state of Montana, spent over $2.5 million to swap in EPA-certified wood stoves in Libby, a town of about 2,700 that had been blanketed in smoke due to winter inversions.

Initially, researchers at the University of Montana found that concentrations of particulate matter fell by about 20 percent and toxic compounds dropped by as much as 64 percent after the program changed out roughly 1,200 stoves. But follow-up studies found that air quality within

homes was highly variable, with some experiencing no changes at all. Libby remains on the EPA's non-attainment list for particulate pollution.

Part of the problem, according to regulators, is that many of these programs focused on replacing ancient, polluting wood stoves with ones that were only marginally better. The EPA first created standards for wood-burning appliances in 1988 but didn't update them again until 2015 — incentives like Montana's, then, were already outdated within a few years. The EPA mandated even stricter measures in 2020, only allowing new stoves to release a maximum of 2.5 grams of particle pollution per hour. The policy passed despite opposition from the Hearth, Patio, and Barbecue Association, which lobbied the government to postpone the guidelines because of the Covid-19 pandemic.

But even the newest stoves might not meet the EPA's latest benchmarks. A March 2021 report by the Northeast States for Coordinated Air Use Management, or NESCAUM, a nonprofit coalition of air quality agencies in the Northeastern U.S., found serious flaws in the EPA's certification process, which relied on laboratory tests that appeared to show lower emissions than the stoves actually released once installed in people's homes.

If the EPA certification doesn't ensure "that new devices are in fact cleaner than the ones they are replacing, then these efforts may be providing no health benefits while wasting scarce resources," the report's authors wrote. The program allows stoves that still emit a sizeable amount of pollution to continue to be installed, they continued, and "once installed, these units will remain in use, emitting pollution for decades to come."

The report put many state environmental agencies in a bind. According to documents Undark obtained via public records requests, just five states that offered financial incentives to replace older wood and pellet stoves with EPA-certified models — Maine, New York, Massachusetts, Vermont, and Idaho — spent more than $13.8 million since 2014 on 9,531 stoves, more than half of which may not actually meet the EPA's current emissions limit. Two additional states, Maryland and Montana, spent a combined $3.9 million on tax breaks and rebates for wood stoves since 2012, though they did not provide details on the specific models that were funded. The Alaska Department of Environmental Conservation made its own list of low-emissions stoves based on additional testing, and has called on the EPA to fix its certification process.

According to Nick Czarnecki, an air quality official in the Fairbanks North Star Borough, the process "really made us question what good a changeout program is if you're just putting in a new wood stove under these circumstances."

In an emailed statement, the EPA said that it is working with NESCAUM to evaluate test methods that the organization has in order to adapt EPA standards. Starting in February, the agency will no longer accept two types of tests, although stoves that used those methods to receive certification will remain in people's homes.

"The Agency is working to improve testing and certification and to strengthen enforcement to ensure that changing out old, inefficient wood burning devices remains an important tool to

reduce particle pollution in communities that use wood for heat," the statement said.

For many air quality regulators and advocates, tweaking wood stove emissions is missing the point. Though reducing emissions in the short term can be beneficial, a longer-term solution would phase out wood stoves altogether, said Laura Kate Bender, the national assistant vice president for healthy air at the American Lung Association.

"Right now, what the science shows us is that there's actually no safe level of particle pollution exposure," Bender said. "There's no amount that's healthy to breathe."

In line with this logic, some agencies are no longer pushing for new wood stoves, and instead funding a transition to alternate heat sources. The Oregon Department of Environmental Quality, which already requires that uncertified stoves be removed when homes are sold, suggests people replace wood stoves with heat pumps.

In Portland's Multnomah County, after a series of meetings on woodsmoke pollution in the summer and fall of 2021, a coalition of local, county, and state organizations recommended the county curtail the use of even EPA-certified wood stoves. In addition to doing this, last month, officials in Oregon issued Multnomah County's fourth-ever burn ban, and announced that bans could be instituted year-round, rather than just in the fall and winter.

"Our target is to have clean air," said John Wasiutynski, the director of the Multnomah County Office of Sustainability in Portland, which convened the group. "And we're not going to get clean air by promoting slightly less bad heating."

John Ackerly, president of the Alliance for Green Heat, a nonprofit that promotes efficiency in residential wood heating, still sees a future in new systems like automatic wood boilers, which burn wood pellets without any intervention from homeowners, reducing the potential for emissions. He said the demand for wood is also cultural and economic, particularly in places that have traditionally relied on forests for fuel.

In the Northeastern U.S., shrinking demand for low-grade wood in recent years has led to the closure of sawmills and the decimation of local economies — but manufacturing pellets would provide a boon for those communities, said Joe Short, vice president of the Northern Forest Center, a nonprofit that focuses on rural community development and conservation in Maine, New Hampshire, Vermont, and New York.

"Different heating solutions work better in certain applications," Short said. "So we just think wood is a good one, for all the reasons we've talked about, should be in the mix, particularly as it's something that we can implement right now, even as we work to make the grid more renewable."

Advanced boilers, though, can run into the tens of thousands of dollars — out of most people's price range without financial help from state governments. Environmental agencies will have to decide whether to support transitional fuels like wood pellets, or invest wholly in alternative heating. But for most of them, the more immediate issue is getting rid of uncertified wood stoves

and discouraging people from burning for recreation — an uphill battle for many who are unaware of the health impacts of woodsmoke.

“People are just sort of like, well, yeah, it stinks,” said Traviss, the Keene air pollution researcher. “But, it’s wood. How bad can it be?”

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http://beta.docker.cancerhealth.com/article/woodburning-stoves-raise-new-health-concerns